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Facility Layaway Economic Analysis

by
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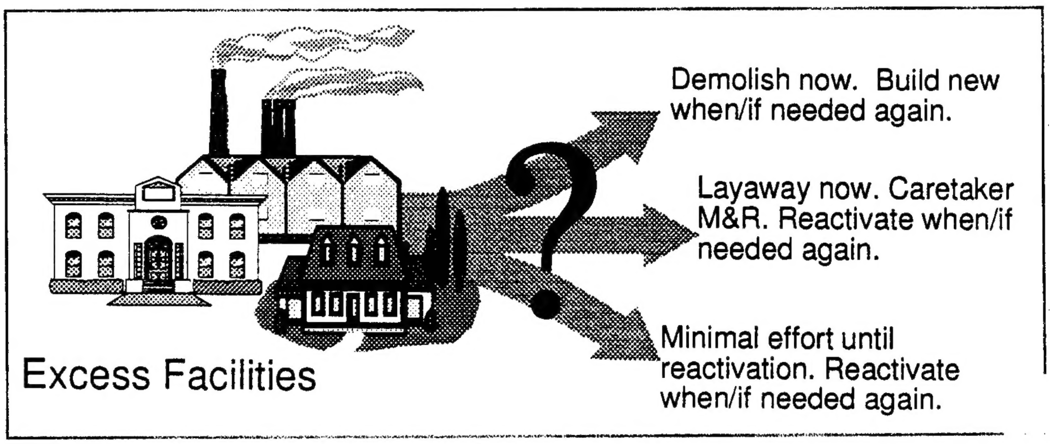

The Army currently has a large number of excess facilities in its inventory. The expense of keeping these facilities places a strain on budgets that have been decreasing in recent years. But uncertainty about future Army requirements raises questions regarding the wisdom of promptly disposing of these facilities. The three most likely alternatives for handling an excess facility are: demolish now and rebuild if the need arises, mothball the facility and care for it until it is needed, and "walk away" from the facility with minimal preparation and interim care until it is needed again. A method is needed for rapidly assessing the costs and risks associated with the alternatives for dealing with excess facilities.

This report describes an economic analysis tool capable of rapidly providing cost comparisons for the three alternatives. The tool is a Microsoft Excel® workbook called the Layaway Economic Analysis (LEA) model. LEA has embedded cost databases and a simple user interface. The results of the analysis of the costs of the three alternatives for seven specific facility category groups using LEA are discussed.

A portion of the current study was devoted to collecting data regarding both the cost of layaway and the deterioration rates of buildings in layaway. This aspect of the problem of excess facilities would benefit from a continued effort to collect data and develop accurate databases to test and validate the LEA model.

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Foreword

This study was conducted for the Office of the Assistant Chief of Staff for Installation Management (ACSIM), sponsored by the Base Realignment and Closure Office, under Military Interdepartmental Purchase Request (MIPR) No. 5ECERLB329, "Layaway Data Analysis," for the Planning Division of ACSIM under the supervision of Dave Yentzer and Jeanne Patterson (DAIM-FDP). The technical monitor is Rich Dubicki (DAIM-FDF).

The work was performed by the Maintenance Management and Preservation Division (FL-P) of the Facilities Technology Laboratory (FL), U.S. Army Construction Engineering Research Laboratories (USACERL). Dr. Simon S. Kim is Division Chief, CECER-FL-P, and Donald F. Fournier is Operations Chief, CECER-FL. The USACERL technical editor was Agnes E. Dillon, Technical Information Team.

The technical assistance of the following USACERL personnel contributed to the successful completion of this work: Robert Neathammer, Dr. Edgar S. Neely, Mark Gardner, Rob Wilson, Jennifer Wetzel, and Jennifer Wilson.

COL James T. Scott is Commander of USACERL, and Dr. Michael J. O'Connor is Director.

Contents

1 Introduction

Background

As a consequence of recent downsizing actions, the Army currently has a large number of excess facilities in its inventory. Unlike the facilities associated with base closures, these facilities are not suitable for economic development because they are located within active installations or they were designed for very specific military purposes and are not easily adaptable to other uses. The expense of keeping these facilities in the inventory places tremendous strains on operations and maintenance budgets that have been steadily decreasing in recent years. Yet uncertainty about possible future requirements in an era when the Army's mission is changing raises questions about the wisdom of promptly disposing of these facilities.

The decision of what to do with a given excess facility is a difficult one. Even if the facility will actually be needed at some future date, intuition says there is a point in almost every facility's life at which replacing it is a better alternative than struggling to maintain it. This is true for active buildings, but even more so for inactive facilities that may no longer receive a level of attention and maintenance necessary to stem the tide of deterioration. If ultimately the facility is not needed again, valuable resources will have been devoted to maintaining a facility when those resources could have been used more effectively elsewhere.

Though more than just economic factors should be taken into account in deciding what to do, economic factors serve as a crucial starting point and yield results that are easily understood and compared. Should the excess facility be demolished and replaced at some future time if the need arises? Should the facility be mothballed and maintained in an inactive state so it can be rapidly prepared when needed again? What is the likely cost of each alternative? And at what point in time and under what circumstances is one alternative less expensive than the other? The answers to these questions do not come easily. Numerous individual costs must be included and vary by type of facility and location. The fact that most costs will occur in the future introduces a high level of uncertainty about them, so risk also must be considered. With the large number of excess facilities in its current inventory, the Army needs a method for rapidly assessing the costs and risks associated with different alternatives for dealing with these facilities.

Objective

The objective of this study was to develop a method for estimating the costs and economic risks associated with various alternative strategies regarding excess facilities and to use that method to determine general costs, risks, and guidelines concerning the alternatives for excess facilities in several specific facility category groups.

Approach

The study limited the number of alternative strategies for excess facilities to the three most likely to occur:

- initial demolition of the facility followed by new construction when and if a future requirement arises
- complete mothballing of the facility with appropriate maintenance and climate control during the inactive period, and full renovation if the facility is required in the future
- a "walk away" strategy using minimum layaway preparation, no maintenance or climate control during the inactive period, and full renovation if the facility is reactivated.

Though the third strategy is not generally desirable, lack of near-term funds to implement one of the other two strategies may make it the only feasible alternative. The second and third alternatives represent the two extremes of the layaway possibilities. The costs and risks associated with intermediate levels of layaway preparation and maintenance were assumed to lie between those of the second and third alternatives.

Two decision points determine the possible outcomes and associated costs for the three alternatives. The first decision point occurs initially, when the decision is made to demolish, mothball, or walk away. The second decision point occurs at an undetermined time in the future when either the facility is needed again or a final decision is made that it will not be needed and must be demolished. The costs associated with each alternative are dependent on the length of time between the two decision points. The study allowed the length of time for the facility to be in an inactive status to vary from 1 to 10 years.

To compare the costs of each alternative, the study identified the unique cost items associated with each alternative, located validated sources of data for each, and constructed a Microsoft Excel® 5.0 workbook to manage the data and perform the calculations. Costs were accumulated over a 20-year period, including operation and

maintenance of the active facility to account for the advantages of the less expensive maintenance, repair, and utility costs for the newly constructed facility under the first alternative versus those of the renovated facility of the second and third alternatives. Current costs were adjusted by escalation rates and discount rates appropriate for the year of occurrence in calculating the net present value (NPV) of each alternative (see Chapter 2 for details).

Discussions with the study sponsor helped to identify the risk factors of most concern. These were: the possibility that the facility might not be needed again, the possibility that the facility will not be able to meet the Army's standards at the time of reactivation, and the possibility that environmental problems within the facility will be considerably more expensive to remedy in the future. To account for these uncertainties, probabilities for each of the risk factors were used in the cost calculations to produce comparable NPVs of expected costs for each alternative. To analyze the risks of these uncertainties, a separate risk analysis model was constructed to link dynamically with the Microsoft Excel® 5.0 workbook (see Chapter 2).

The Microsoft Excel® 5.0 workbook and the risk analysis tool were used in the analysis of five scenarios for seven facility types (see Appendices A through H for specific results). The five cases were:

- a baseline comparison of costs for the three alternatives when the need for and adequacy of the excess facility is certain and environmental problems are not involved
- a comparison of costs for the three alternatives when the excess facility may never be needed again
- a sensitivity analysis to determine the least expensive alternative as a function of the probability that the facility will be needed and the probability that it will be adequate when no environmental problems are involved
- a sensitivity analysis to determine the least expensive alternative as a function of the probability the facility will be needed and the probability that it will be adequate, when environmental problems are involved
- a sensitivity analysis to determine the least expensive alternative as a function of the level of possible increase in environmental costs and the probability that such an increase will occur (see Chapter 3 for a discussion of the results).

2 Study Approach and Data Sources

This study was undertaken to determine the costs and economic risks associated with various alternatives for handling a single, excess facility. The study focused on the three most likely strategies:

- demolish the facility and, if the facility is required again, replace it with new construction of the same function and square footage but with up-to-date building standards
- lay the facility away, maintain it in its inactive state, then reactivate it at a future date when it is needed again
- lock the facility and walk away with no effort to restore or maintain it during its inactive state, and reactivate it at a future date when it is needed again.

The analysis considered the total expected cost of each strategy over a 20-year period, beginning with the initial decision to layaway, walk away, or demolish, through the reactivation or reconstruction of the facility within 10 years of the initial action, and continuing with the operation and maintenance of the facility in the 10 or more years following its reactivation or reconstruction. A Microsoft Excel® 5.0 workbook was constructed to manage the required data and to calculate the costs. A risk analysis tool called Decision Analysis by TreeAge® 2.66 (DATA) was dynamically linked with the workbook to analyze the risks due to uncertainties about whether the facility actually will be needed in the future; whether the facility, if needed, will meet standards existing at the time; and whether environmental problems associated with the facility will worsen either through a growth in the level of contamination or a growth in the expense of clean-up.

This chapter contains a description of the Microsoft Excel® 5.0 workbook used for the baseline calculations and a description of the risk analysis method. It also identifies the costs that were considered for each alternative and the source of each of the data sets required to complete the cost calculations.

Design of the Basic Economic Analysis Model

Method

The first goal of the study was to determine a good estimate of the costs associated with each alternative listed here. The intention was not to include every cost that could be counted as an expense under a given alternative but to identify the costs that were incurred under one alternative but not another, or the costs that were different in amount or time of occurrence from one alternative to another. Because the operation and maintenance of a new facility is generally less expensive than that of an older structure, the time period over which costs were accumulated included some portion of time after the facility is reactivated or rebuilt. The prime question was: "How long can the facility be inactive under layaway or walk away before the cost of that alternative equals the cost of demolishing the facility and rebuilding it?" Therefore, the number of years between the decision to layaway/walk away/demolish and the need to reactivate/rebuild was considered an independent variable.

With these considerations in mind, the costs associated with each of the alternatives were accumulated for a 20-year period. The time between the initial decision and the reactivating/rebuilding was allowed to vary from 1 to 10 years, with 10 or more years remaining in the cycle for the operation and maintenance of the new or reactivated facility.

The study used a Microsoft Excel® 5.0 workbook called the Layaway Economic Analysis (LEA) model to manage both the calculations and the data required for them. LEA contained a spreadsheet for each alternative and for each cost type. Each alternative contained 10 "scenarios," one for each of the possible years in which reactivating/rebuilding was to occur. Within a particular scenario (i.e., for a given year of reactivation), a row was entered for each possible type of cost for that alternative, and the actual line-item cost was entered under a column representing the year from 1 to 20 in which the cost was incurred. Each cost was expressed as a current year cost increased by an escalation factor and discounted to the present time. Escalation rates and discount rates are among the variables that may be changed by the LEA user. For the current study, escalation rates were set at 3 percent and the discount rate at 7 percent. Totals for each of the column years indicated the NPV of the cost of the alternative during that year, and the sum of these yearly totals over the 20-year period yielded the discounted cost of the alternative for the given year of reactivation. The study analyzed the 20-year NPV of each alternative for different years of reactivation.

The uncertainty of future events was handled by computing the expected value of costs from probabilities of occurrence assigned through user input. In addition, a separate

risk analysis model was built on top of LEA using the software package called DATA. The risk analysis model is described later in this chapter. LEA considered only two sets of uncertain complimentary events: that the facility may or may not actually be needed at some future date and that the original facility, if needed later, may or may not be able to meet the existing standards for a facility of its type. Each cost associated with the occurrence of one of these events was multiplied by the appropriate probability.

The inputs to the LEA model consist of a brief list of facility attributes, probabilities associated with the uncertainty factors, and a brief description of the presence of hazardous materials. The facility attributes include: facility category group, geographic location, age of facility, net square footage, type of exterior wall, and current condition as measured by the Army's Installation Status Report (ISR) standards using the red/amber/green designation. The probabilities required for LEA are: the facility will be needed again and the facility will be able to meet the standards for its type. The inputs for hazardous materials include whether lead-based paint is present on more than 30 percent of the surface areas of the facility, and whether asbestos is present in the roofing material, siding, flooring, or insulation. These few inputs were sufficient to estimate the costs associated with each alternative.

Costs for Layaway/Reactivate and Walk Away/Reactivate

The costs uniquely associated with keeping the facility for later reuse included: initial layaway costs, caretaker costs (maintenance, repair, climate control), restoration and renovation costs, operation and maintenance (O&M) costs (maintenance, repair, climate control) for the active facility, and any costs for required remediation of environmental problems (e.g., lead-based paint and asbestos). The differences between the layaway and walk away strategies were in the initial layaway and caretaker costs—which are minimal for walk away—and in restoration/renovation costs—which vary according to the type and initial condition of the facility, the level of maintenance during the inactive period, and the length of the inactive period. The costs to restore and operate the facility after its inactive period were affected by the probability that the facility may not be needed again and by the probability that, if needed, the facility will be able to meet the standards existing at the time of reactivation. In these two instances, the cost to demolish the facility and the cost to construct a new facility if the facility is needed but inadequate were added to the costs in proportion to the probabilities of the two events. The restoration/renovation costs and active O&M costs were adjusted appropriately to account for the diminished probability of their being incurred, or for the reduced costs associated with operating a new building versus an older one.

Costs for Demolish/Rebuild

The costs uniquely associated with demolishing the facility, then, if such a facility is required again, with constructing a new facility included: the cost of demolition and disposal, new construction costs, O&M costs (maintenance, repair, climate control) for the active facility, and any required cleanup and disposal costs for lead-based paint and asbestos. The probability that the facility may not be needed again reduced the new construction costs and O&M costs proportionately.

Data Sources

The cost calculations for each strategy were based on the net floor space of the facility and a per square foot cost factor adjusted for the year of occurrence by a 3 percent per year escalation rate. The individual cost factors were taken from the following sources.

Maintenance and Repair Costs for Initial Layaway and Caretaker Activities

The maintenance and repair (M&R) costs for the initial layaway and caretaker activities were taken from a USACERL special report (Cork et al., February 1995).

Restoration/Renovation Costs

The costs for the layaway and walk away strategies were the sum of the total major replacement and high cost tasks (MRT) that would have arisen during the years the facility was inactive, and the renovation costs determined by a study algorithm using the Army's ISR renovation factors. The MRT costs were taken from a report by Neely and Neathammer (Vol. II, 1991). Updated ISR renovation factors were provided electronically by the ISR point of contact at the U.S. Army Cost and Economic Analysis Center (personal communication, October 1995).

The assumption for the layaway strategy was that a facility in caretaker status would decline from a green condition to an amber condition in 10 years, and from an amber condition to a red condition in 6 years. A linear growth in the renovation cost was assumed, beginning with the cost associated with the initial condition of the facility. For the layaway strategy, this meant an additional 1/10 of the amber renovation factor for each year in the period from green to amber, and an additional 1/6 of the red renovation factor for each year from amber to red. It also was assumed that a facility in red condition at the beginning of the inactive period would require an additional 1 percent of the red renovation factor for each inactive year.

For the walk away strategy, the assumption was that a facility in an abandoned state would decline from a green condition to an amber condition in 6 years and from an amber condition to a red condition in 4 years. A linear growth in the renovation cost was assumed, beginning with the cost associated with the initial condition of the facility. That is, an additional 1/6 of the amber renovation factor for each year in the period from green to amber and an additional 1/4 of the red renovation factor for each year from amber to red. Also it was assumed that a facility in red condition at the beginning of the inactive period would require an additional 2 percent of the red renovation factor for each inactive year.

The derived renovation rates for specific locations were adjusted in the same manner as the construction costs for the geographic region by the method outlined in Area Cost Factor Indexes, in the PAX Newsletter* No. 3.2.1, 15 June 1995.

Annual M&R of the Reactivated/Rebuilt Facility

Costs for the annual M&R of reactivated or rebuilt facilities were taken from a USACERL report (Neely and Neathammer, Vol. II, May 1991).

Annual Fuel Costs for Active and Inactive Facilities

The annual fuel costs for active and inactive facilities were taken from the Department of Energy reports (April 1992 and February 1993). The government utility rate was assumed to be half of the commercial rate. For specific locations, the workbook calculations included an adjustment for the climatic zone of the region determined by the average yearly heating and cooling degree days.

Facility Demolition Costs

Cost estimates for facility demolition were taken from the Cost Estimates - Military Construction, in the PAX Newsletter No. 3.2.2, 15 June 1995.

Cost of New Construction

ISR new construction rates were provided electronically by the ISR point of contact at the U.S. Army Cost and Economic Analysis Center, October 1995. These rates were adjusted for geographic location by the method outlined in Area Cost Factor Indexes, in the Pax Newsletter No. 3.2.1, 15 June 1995.

* From Huntsville Division, U.S. Army Corps of Engineers.

Lead-based Paint Removal/Disposal

The cost to remove lead-based paint was based on the amount of materials in a standard building as outlined by Lufkin and Pepitone (1994), and on removal and disposal costs from the Means Company (1994).

Asbestos Removal

Cost to remove asbestos was based on using the amount of materials in a standard building as outlined by Lufkin and Pepitone (1994), and asbestos removal and disposal costs from the Means Company (1994).

Uncertainties

If the decision maker knows with certainty whether a specific facility is going to be needed or not and, if so, when it will be needed again, the decision of whether to lay a facility away or to demolish it is straightforward and can be supported by cost-effectiveness analysis. Simply total the costs in present dollars for each alternative and choose the alternative with the least total cost.

Unfortunately, certainty about future requirements is a rare event. If the decision maker does not know the installation's facility requirements with certainty, a layaway decision becomes a risky one. In this case, the cost (c) of building a new facility if the need arises is not a certain cost, and a straightforward comparison of alternatives is not possible. If the decision maker knows the probability (p) of needing the facility in the future, he/she can compute the expected cost as the product of c and p. Choosing the alternative with the least expected cost will be the most cost-effective strategy over the long run if the decision maker makes many such decisions for a large number of independent facilities. The study's LEA model computes this type of expected net present value for each alternative. However, a given individual facility may have costs for the three alternatives that differ substantially from the expected costs. So the study developed a decision analysis tool to explore how sensitive a given decision is to the uncertainties and to establish bounds for the risks involved.

The future facility requirement is not the only uncertainty for the three alternatives. The study considered three more uncertain events that have a significant impact on the final cost of each alternative, namely: future cost of environmental restoration, accidental destruction of the mothballed facility, and changes in the functional requirements of the facility. All four uncertain events are represented in Figure 1,

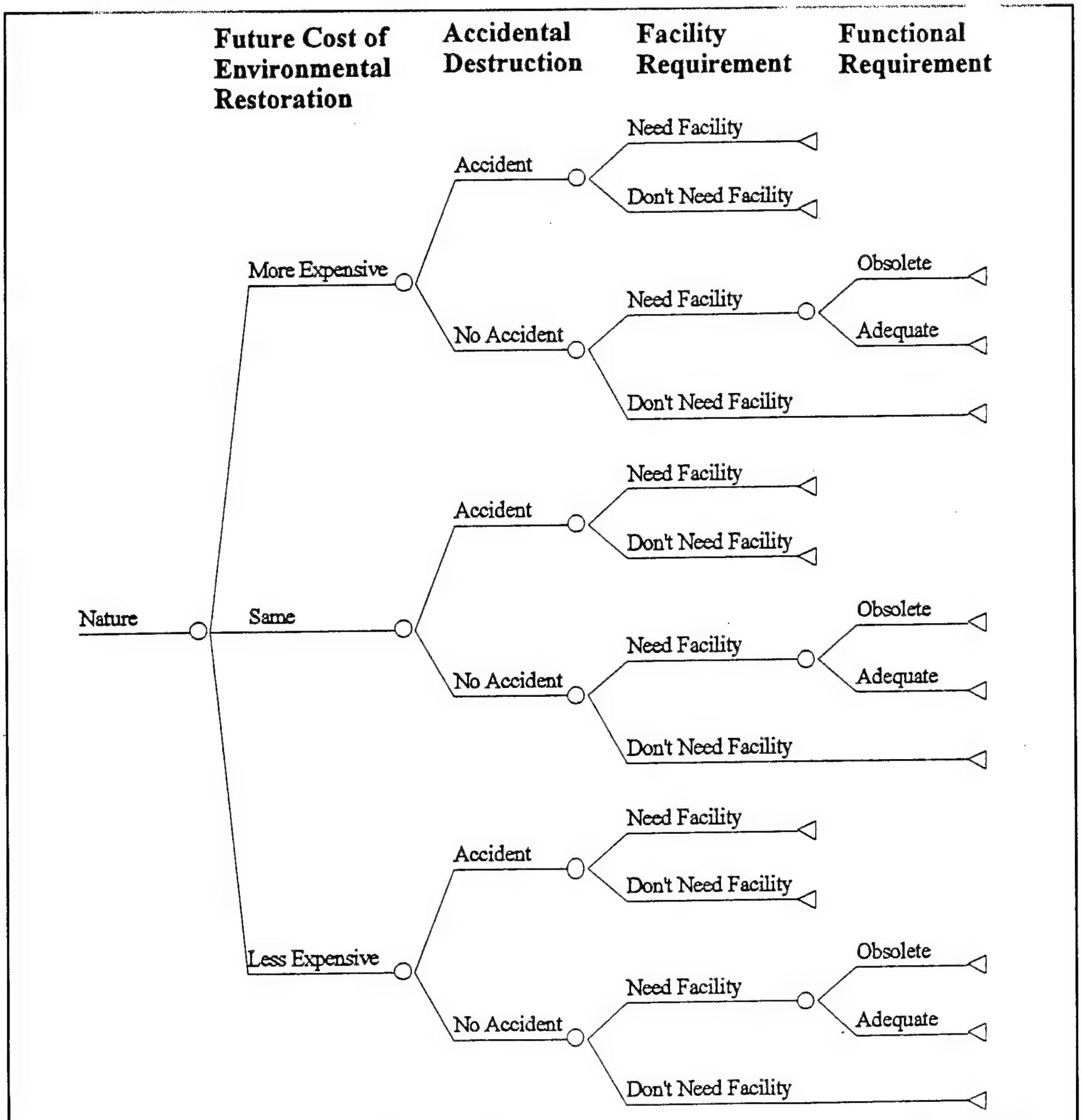

Figure 1. Nature's tree for facility layaway decision.

although the study results reported here do not include consideration of the economic consequences of accidental destruction of the mothballed facility.

The uncertainty in the future cost of environmental restoration is due to the continuous change in environmental regulations and technologies. For instance, removing asbestos from a building is more expensive now than it was 10 years ago. But, future technological improvements may reduce the cost of cleaning up some contaminants, making the future cost of environmental restoration less expensive than current costs. This uncertainty is represented in the tree of Figure 1 by the three

branches named "More Expensive," "Same," and "Less Expensive" coming out of the left-most node named "Nature." The probability associated with each branch depends on the materials inside the facility and the facility's state of preservation.

Accidental destruction of the facility impacts the cost analysis in two ways. For example, an accidental fire destroys a mothballed facility containing asbestos that was originally encapsulated and hence not representing any health hazard. In addition to the loss of the facility, the fire also destroys the encapsulation of the asbestos fibers. The site becomes a health hazard and, as a consequence, more expensive to clean up. That is usually the case with most accidents; the cost of cleaning up after the accident is greater than the cost of demolishing the facility in an orderly manner. The probability of an accident happening depends on the state of the facility when mothballed and the level of mothballing selected.

The last uncertainty in Figure 1 is posed by the functional requirements the facility will have to meet in the future. For instance, a training facility that meets today's standards is mothballed now. Five to 10 years from now, the facility may be obsolete because of emerging technologies in training and the cost of bringing it up to acceptable standards may be extremely high. The probability of this happening depends on the type of building and its age.

In this model, the decision maker has three alternatives: demolish the facility, lay it away, or walk away from it. These three alternatives are represented in Figure 2. After one of the three alternatives is chosen by the decision maker, "nature" takes over and chooses which path to follow and, hence, which final outcome results. There are a total of 32 possible paths in this tree, and each one has a different probability of happening and a different cost.

The study's DATA model estimates the cost associated with each path of Figure 2. The exogenous variables of the model are: facility type, size, age of facility, location, type of hazardous materials present in the facility, and number of years until the facility is needed again. In addition, this study considered the probabilities associated with each chance node of the tree: probability of change in environmental regulations, probability of accidental destruction, probability of actually needing the facility, and probability of the facility becoming obsolete.

This decision model is made up of two parts, each one running in a different software package. All data inputs to the model as well as the economic model itself reside in the Microsoft Excel® 5.0 workbook LEA. The decision tree part of the model is done in DATA, which works with LEA through dynamic links.

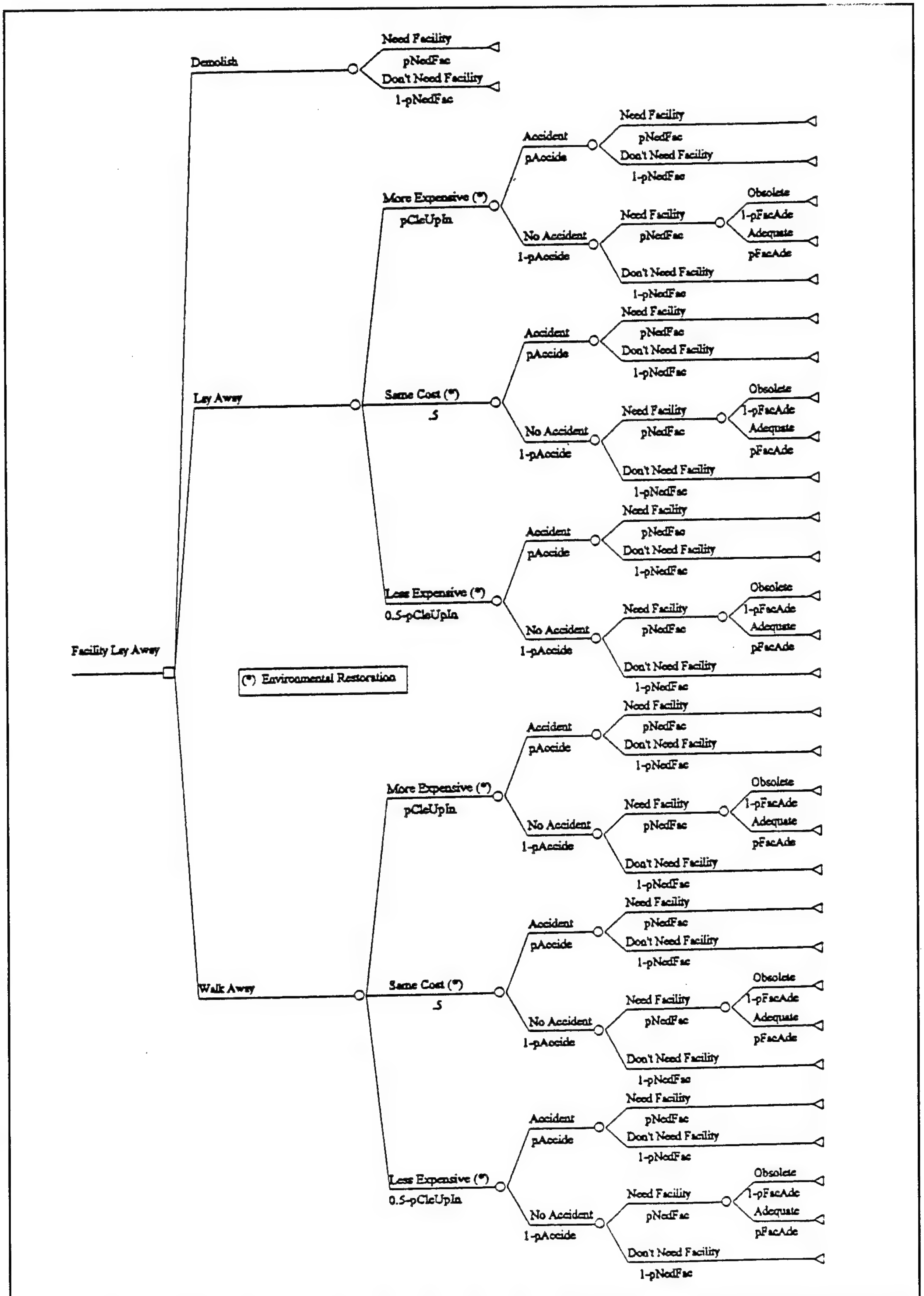

Figure 2. Facility layaway decision tree.

The optimal policy to follow for making this decision depends on the amount of information the decision maker has at the time and on the decision maker's attitude toward risk. If the decision maker knows the probabilities associated with the chance nodes of Figures 1 and 2, the model can compute the total cost and the probability of each "leaf." The risk associated with each alternative is described by the probability distribution of all the paths following that alternative, and different decision makers may react differently to it. If the decision maker is making this decision with several buildings of similar characteristics, the risk of the actual cost being different in the long run from the expected cost is minimum, and the least expected cost policy rule is the best policy. However, if the decision maker cannot bear the risk associated with the probability of the worst case scenario happening, the best policy rule is to choose the alternative with the minimum maximum cost.

The two extremes described here may well be the case for decision makers at the Major Army Command (MACOM) level and at the installation level. At the MACOM level the decision maker is faced with large numbers of similar buildings scattered around different installations. As a consequence of the large number of buildings, the total average cost of the policy will be close to the expected total cost. However, at the installation level the decision maker faces a smaller number of buildings and, as a consequence, the actual cost may differ significantly from the expected cost. Hence, minimum expected cost may not be the optimal rule at the installation level.

If the decision maker does not know the probabilities associated with the chance nodes of the tree (Figure 2) or is not able to estimate them satisfactorily, it is not possible to compute expected cost and, hence, not possible to choose the alternative with the least expected cost. This situation is called "decision making under uncertainty" by decision theorists, and the optimal policy rule is more abstract. The most popular decision rules are: Laplace Rule, Minimax Rule, Minimin Rule, Hurwicz Rule, and Minimax Regret Rule. Each decision rule makes a different assumption regarding the probability of each outcome and, as a consequence, the recommended alternative may be different.

The Laplace Rule assumes that each possible state of nature is as likely to occur as any other. The rationale is that there is no stated basis for one state of nature to be more likely than any other. In other words, nature is assumed to be indifferent between outcomes. Under this assumption, the optimal policy rule is to choose the alternative with the least average cost.

The Minimax Rule assumes an extremely pessimistic view of the outcome of nature. This rule assumes that nature will do her worst. The optimal policy rule under this assumption is to choose the alternative with the smallest maximum cost. However,

the Minimin Rule is based on an extremely optimistic view of the outcome of nature. This rule assumes that nature will do her best. The optimal policy rule under this assumption is to choose the alternative with the least minimum cost.

In between these two extremes is the Hurwicz Rule, which assumes that the outcome will be something in between the optimistic and pessimistic ones and allows the decision maker to select an index of optimism, a, between 0 and 1. If the decision maker is optimistic, then a=1, and if the decision maker is pessimistic then a=0. The expected outcome for each alternative is assumed to be a times the optimistic outcome plus (1-a) times the pessimistic outcome. The optimal policy rule then is to select the alternative with the least expected cost.

The Minimax Regret Rule assumes that a decision maker regrets the selection of one alternative if ultimately another alternative yields a better result. This rule is based on the premise that a decision maker wishes to minimize the maximum regret.

Each rule has a different objective and recommends a different alternative as optimal. In other words, there is no unique optimal alternative, and the recommended alternative depends on the personality of the decision maker and the decision maker's perception of the natural events. Therefore, there is a need for both a qualitative and quantitative understanding of the uncertainties involved in this decision.

3 Analysis Results

The study's LEA model and the companion risk analysis tool were used to consider a set of seven types of facilities under five scenarios. The five scenarios were:

- a baseline case, with 100 percent probabilities that the excess facility will be needed in the future and that it will be adequate to meet existing standards
- a case with 0 percent probability that the excess facility will be needed again
- a sensitivity analysis for the baseline case when no environmental problems are involved as both the probability that the facility will be needed and the probability that it will be adequate vary from 0 to 1
- a sensitivity analysis for the baseline case when environmental problems are involved as both the probability that the facility will be needed and the probability that it will be adequate vary from 0 to 1
- a sensitivity analysis on the baseline case to determine how much worse the environmental problems can get before a different alternative should be chosen.

This chapter describes the analysis method and summarizes the results. Appendix A contains brief notes and observations to assist in interpreting the graphical displays in the other seven appendices (B through H), which contain more specific information about the individual cases.

Assumptions and Scenario Set-Up

The LEA model was designed to calculate the NPV of each of the three alternatives (layaway/reactivate, walk away/reactivate, and demolish/rebuild) for a wide variety of specific facility types and attributes. When used interactively, three sets of input data are required:

- the facility description (facility category group, geographic location, age, net floor space, exterior wall material, and current condition)
- probabilities for reuse and adequacy
- an environmental problems checklist for lead-based paint and asbestos.

These inputs serve as filters for the Microsoft Excel® 5.0 workbook's databases containing the cost factors used in the calculations.

For the current analysis, a standard set of inputs was required for the particular scenarios being studied. Following are descriptions of how each of the inputs was chosen.

Facility Category Group

The facility category groups used for analysis were taken from a list of facility types requested by the study sponsor. The sponsor's list included: operations buildings, administrative facilities, aircraft maintenance hangars, production facilities, general instruction buildings, barracks, and family housing. Because the Army's ISR data were the best available source for renovation and new construction costs, the specific facility category groups for the study were chosen from the ISR database. The following seven categories were analyzed:

- 14185 - company headquarters buildings
- 17120 - general instruction buildings
- 21110 - aircraft maintenance hangars
- 22600 - ammunition production facilities
- 60000 - administrative facilities
- 71100 - family housing dwellings
- 72100 - unaccompanied personnel housing, enlisted facilities.

The cost factors for 14182 (brigade headquarters buildings) and 14183 (battalion headquarters buildings) were almost identical to those for 14185, and results for 14185 can be assumed to apply to the other two groups.

Geographic Location

The geographic location affects all of the costs in one of two ways. If the cost is related to demolishing, maintaining, renovating, or constructing a facility, the base rate is multiplied by an area cost factor to account for variations in labor, equipment, and material costs in different regions of the country. If the cost is related to climate control, a climatic zone factor is applied to the base utility rate. For this analysis, Fort Leonard Wood, MO, was chosen as the location for all cases because its area cost factor is very close to 1 (1.02) and its climatic zone is 3 (zones vary from 1 to 5). Having the study results apply to a "middle" case means that reported costs should be increased for locations such as Alaska, which has much higher factors in both area costs and climate, and should be decreased for locations such as the southeast region of the United States, which has much lower area and climate control costs.

Age

At first glance, the age of a building would seem to be a decisive factor in determining the most cost effective alternative for an excess facility. However, the available evidence points to the current condition of the building as being a more reliable indicator of the costs that will be incurred in the layaway and walk away alternatives. Although the study did not produce any results in terms of the age of the facility, a particular age had to be chosen for the facilities being analyzed because cost factors for maintenance and repair are based on age. The study chose an age of 25 years for several reasons. This would place the facility's construction in 1970, during the Vietnam War era when many of the current excess facilities were built. These buildings are now approaching their highest levels of operations and repair expenses. Between the ages of 25 and 35 years, buildings incur their highest component replacement costs—new roof, new furnace, plumbing and electrical overhauls, etc. In addition, utility data from the Department of Energy (April 1992, February 1993) indicate that commercial buildings and houses constructed between 1965 and 1984 have the least efficient energy consumption of all buildings to date. In other words, the costs for the layaway and walk away alternatives will be at their highest levels for facilities which currently are 25 to 35 years old.

Net Floor Space and Exterior Wall Material

To establish a square-foot size for each of the facility types, the study used data from PAX Newsletter No. 3.2.2, 15 June 1995. The exterior wall material affects only the cost of demolition of the facility. The sizes and exterior wall materials in Table 1 were used for this analysis.

Table 1. Building sizes and exterior wall materials.

Type	Size (SF)	Exterior Wall
14185 - Company headquarters buildings	8000	Masonry
17120 - General instruction buildings	38,000	Masonry
21110 - Aircraft maintenance hangars	23,000	Metal
22600 - Ammunition production facilities	40,000	Concrete
60000 - Administrative facilities	25,000	Masonry
71100 - Family housing dwellings	1500	Wood
72100 - Unaccompanied personnel housing, enlisted facilities	99,500	Masonry

Current Condition

The current condition of the facility is expressed in terms of the Army's ISR standards of green, amber, and red. The predominant cost for the demolish/rebuild alternative is the new construction cost, and for the layaway and walk away alternatives it is the restoration/renovation cost. The cost factors used for construction and renovation were all taken from the ISR database to ensure consistency. The study made several important assumptions about how the rates of deterioration under layaway and walk away are related to the renovation costs. These assumptions are outlined in Chapter 2 under "Data Sources." Because the costs of the layaway and walk away alternatives are dependent on the initial condition of the facility, the baseline scenario is reported for all three initial conditions. The second scenario is not dependent on the condition of the facility. For the third, fourth, and fifth scenarios, the study assumed a green initial condition.

Scenario 1. The Base Case

The first step in the analysis was to determine the point at which the expenses of keeping and reactivating an inactive facility are equivalent to demolishing and rebuilding it. For this base case, all uncertainties and environmental problems were removed. That is, the probability that the facility will actually be needed in the future is 100 percent; the probability that the facility will be able to meet future standards when reactivated is 100 percent; and the facility does not, nor will it, have any environmental problems that will increase costs.

The results of this analysis are reported for each facility in the appendix under the titles "Comparison of 20-Year Costs by Initial Condition" and "Layaway/Walk Away as Percentage of Demolish/Rebuild." These results show that the demolish/rebuild alternative is always the most expensive alternative for an inactive period of 10 years or less, i.e., there is no point at which the layaway or walk away alternative and the demolish alternative are equally attractive options because of the high cost of new construction.

When the excess facility is in green condition, the results show that the layaway/reactivate alternative is the least expensive. That is, if the facility is in good condition, keep it and take care of it.

When the excess facility is in amber condition, the NPV of the costs for both the layaway and the walk away alternatives increases substantially as the inactive period lengthens until the facility reaches a red condition (year 5 for walk away and year 7

for layaway). For inactive periods of 7 years or longer, both alternatives parallel the costs of a facility initially in red condition. This is primarily a result of the study's assumed deterioration rates and the dominance of the restoration/renovation costs in the overall expense of the alternative.

When the excess facility is in red condition, the layaway and walk away alternatives are almost identical in NPV costs. Essentially, the facility cannot deteriorate much more than its initial condition, so there is little advantage to maintaining it at any level during the inactive period. As a percentage of the NPV cost of the demolish/rebuild alternative, both the layaway and the walk away alternative have NPV costs that are within 65 to 90+ percent for all facilities considered.

The dominant cost in all of the alternatives is the rebuilding/reactivating costs, which were taken from the ISR data. As can be seen in Table 2, the renovation costs vary substantially relative to the rebuild costs for facilities.

Scenario 2. Facility Not Needed in the Future

Scenario 2 considers that the facility ultimately may not be needed. For the demolish/rebuild alternative, the NPV of accumulated costs is simply the initial cost to demolish the facility, regardless of the length of the inactive period. However, for the layaway and walk away alternatives, the NPV of costs includes all of the expense of caring for the facility during the inactive period as well as the ultimate demolition of the facility at the end of the inactive period.

Table 2. Renovation and rebuild costs.

	Cost per Square Foot		
Type	Amber Renovation	Red Renovation	New Construction
14185 - Company headquarters buildings	66.55	100.97	156.52
17120 - General instruction buildings	58.57	88.87	130.67
21110 - Aircraft maintenance hangars	25.49	76.48	139.59
22600 - Ammunition production facilities	58.45	91.77	164.15
60000 - Administrative facilities	58.99	89.50	139.08
71100 - Family housing dwellings	38.51	64.11	104.08
72100 - Unaccompanied personnel housing	30.57	73.32	153.88

The results of this analysis are reported for each facility in the appendix under the title "Comparison of Costs if Facility Is Never Reactivated." Except for 14185 and 17120, all of the other facilities have the same predictable pattern: the demolish/rebuild alternative has the least NPV cost, followed by the walk away alternative, with the layaway alternative being the most expensive and growing as the length of the inactive period increases. For facilities of type 14185 and 17120, the cost of the walk away alternative during the inactive period increases at a rate smaller than the discounting. Discounting at the 7 percent annual rate means that postponed costs are smaller than current costs. Thus, for facilities of type 14185 and 17120, the walk away alternative is the least expensive.

Scenario 3. Sensitivity to Need and Adequacy—Without Environmental Problems

In Scenario 3, the LEA model was configured with the same parameters as the base case for each facility, although only an initial condition of green with reactivation in the sixth year was considered. The DATA risk analysis model used this data to test the sensitivity of the decision node in Figure 2 to the probability that the facility will be needed and the probability that the facility will be adequate. The DATA model varied these two probabilities from 0 to 1 and identified regions of values for the probabilities in which a particular alternative would have the least expected NPV of costs.

The results of this analysis are reported for each facility in the appendix under the title "Least Cost Alternative—Without Environmental Problems." These graphs in Appendixes B through H fall into one of three categories. For 21110, 60000, 71110, and 72100, all three alternatives appear as the least cost alternative for some region. The layaway alternative is chosen for the region in which both probabilities are high. The demolish alternative is chosen in the region in which both probabilities are low. And the walk away alternative is chosen in the region between the two extremes. For 14185, 17120, and 22600, only the layaway and walk away alternatives appear as the least cost alternative for some region. In this case, taking a "wait-and-see" attitude appears to be justified because of the significantly higher cost of replacing the facility and the discounting that favors postponing expenses.

Scenario 4. Sensitivity to Need and Adequacy—With Environmental Problems

Scenario 4 is similar to Scenario 3, except the cost of restoration/renovation or future demolition is increased to five times over the current costs to account for a radical

increase in the expense of cleaning up hazardous materials. The future costs of removal or remediation of hazardous materials are extremely difficult to predict. Costs might increase because of more restrictive regulations, increased disposal costs, increases in the amount or type of contamination, or a combination of all three. Currently two events trigger costs for hazardous materials: demolition and renovation. This scenario was designed to test the baseline case by adding a large future environmental cleanup expense to the layaway and walk away alternatives.

The results of this analysis are reported for each facility in the appendix under the title "Least Cost Alternative—With Environmental Problems." Five of the seven facility types (14185, 17120, 22600, 60000, 71110) have similar results. When the probabilities that the facility will be needed and that the facility will be adequate are both high, the least cost alternative is demolish/rebuild. The expected cost of renovating the original facility exceeds the cost of disposing of the facility now and rebuilding it when needed. As the certainty of need and adequacy diminishes, the walk away alternative becomes the least cost alternative. The other two facility types (21110, 72100) have only the walk away alternative as their least cost alternative, regardless of the probability of need or adequacy. These two facility types have a small amber renovation cost relative to the new construction cost. So the 5-fold increase in renovation still does not exceed the cost of a new building.

In this scenario, the layaway alternative is never the least cost alternative. This is due to the parameters of the scenario. The original condition of the facility is green, and the year of reactivation is the sixth year. The first group of facilities (14185, 17120, 22600, 60000, 71110) has relatively high amber renovation costs; the second group (21110, 72100) has relatively low amber renovation costs. For both groups, when the probabilities of need and/or adequacy are low, the best strategy is "wait and see" with no upfront expenses—hence walk away. When the probabilities of need and adequacy are both high, the two groups have different least cost alternatives. For the first group, both layaway and walk away surpass demolish/rebuild. For the second group, the layaway and walk away alternatives have almost identical expected costs when the inactive period is less than 7 years. Though the sensitivity analysis identifies the least cost alternative for the decision node, it does not indicate how close or far apart the expected costs are for each alternative. For the second group in this scenario, the baseline scenarios indicate that the expected costs of the layaway and walk away alternative are almost equal.

Scenario 5. Sensitivity to Increases in Environmental Costs

In Scenario 5, the LEA model was configured with the same parameters as the base case for each facility, although only an initial condition of green with reactivation in the sixth year was considered. The DATA risk analysis model used this data to test the sensitivity of the decision node in Figure 2 to the probability that the cost of environmental problems will increase and to the level of that increase. The method by which the DATA model was structured was to assume that either the demolition cost or the renovation cost (including present known costs for lead-based paint and asbestos) would be increased. The DATA model tested the decision node to determine the values for the probability and the increase for which a particular alternative would be chosen for having the least expected NPV cost.

The results of this analysis are reported for each facility in the appendix under the title "Least Cost Alternative—Environmental Problems Increase." This scenario assumed that the facility is in green condition and that reactivation of the facility occurs in the sixth year. As in Scenario 4, the same two groups of facilities emerge, probably for the same reasons described in the earlier scenario.

Facilities of type 14185, 17120, 22600, 71110, and 60000 each favor the demolish/rebuild alternative after a 3- to 4-fold increment in cost when the probability that the environmental costs will increase is high. They also favor the layaway alternative when the probability of an increase is low. When the probability of an increase is high but the increase is less than 4-fold, the walk away alternative has the least expected NPV cost.

Facilities of type 21110 and 72100 have different sensitivities. Facility type 21110 requires a 6.5-fold increase in environmental costs before the option to demolish and rebuild is the least cost alternative. Facility type 72100 requires an 8-fold increase.

4 Summary

This study focused on analyzing the cost and economic risks associated with the three most likely strategies for handling an excess facility:

- demolish the facility and, if such a facility is required again, replace it with new construction of the same function and square footage but with up-to-date building standards
- lay the facility away, maintain it in its inactive state, then reactivate it at a future date when it is needed again
- lock the facility and walk away with little effort to restore or maintain the facility during its inactive state, then reactivate it at a future date when it is needed again.

Computer tools and available macro-level databases were used to estimate the net present value of the cumulative cost of each alternative and to study the sensitivity of the least cost alternative to uncertainties about the future requirement for the facility, its ability to meet future standards, and the impact of radical growth in the cost of cleanup of its hazardous materials. Seven facility category groups were analyzed during the study (see Appendix B through H).

Following are some general observations, conclusions, and recommendations:

- The study's LEA model provides a quick estimate of the costs and risks of each of the three alternatives. Distribution of this Microsoft Excel® 5.0 workbook to decision makers considering facility layaway options would ease much of the effort required to gather and process cost data so a "first-cut" decision could be made quickly.
- Although the analysis reported here included only seven facility types under five scenarios, the Microsoft Excel® 5.0 LEA model and the DATA risk analysis model are flexible enough to produce expected cost estimates for a wide variety of facilities, locations, and economic environments.
- The analyses are based on macro-level planning data. The costs for the alternatives are expressed in net present value and do not include all of the costs of each alternative but only the costs that are uniquely different for that alternative.

- The study showed that the cost of replacing a facility in good condition and with no environmental problems is always considerably higher than the cost of keeping it for later use. If it is known that the facility will be needed later, the best option is to keep it and take care of it.
- The study results are biased toward an economic environment that favors postponing expenses. This is because the study assumed escalation rates of 3 percent and discount rates of 7 percent. Although changes in these rates would not change the earlier conclusion that rebuilding is more expensive than laying away, reducing the discount or increasing the escalation rate would tend to favor the layaway alternative over the walk away alternative.
- The sensitivity analysis shows that the least cost alternative is extremely dependent on the probabilities that the facility will be needed and adequate. The results show that the order of preference for the alternatives reverses as these probabilities decline. Layaway decisions should be made with careful consideration of these two probabilities.
- When environmental problems are introduced, the least cost alternative depends on the probability that cleanup costs will increase and on how much that increase will be. In this situation, there is a point at which demolishing a facility that will be needed later and then rebuilding it is a less expensive alternative than keeping it for later use.
- The quality of the analysis tools is dependent on the data used. Although the Army has well established cost databases for most of its activities, layaway actions are relatively new and the costs associated with preparing a facility for layaway and taking care of it while it is in layaway are not well established. In addition, little consensus exists about the factors that determine the level of deterioration of a building while it is in layaway or the factors that determine the costs of restoring the facility for active use. In the current analysis, the results were strongly influenced by the study's assumptions regarding deterioration rates and the associated restoration costs. Although a portion of the current study was devoted to collecting data regarding both the cost of layaway and the deterioration rates of buildings in layaway, this is an area that would benefit from a continued effort to collect data and to develop accurate databases to test and validate the model.

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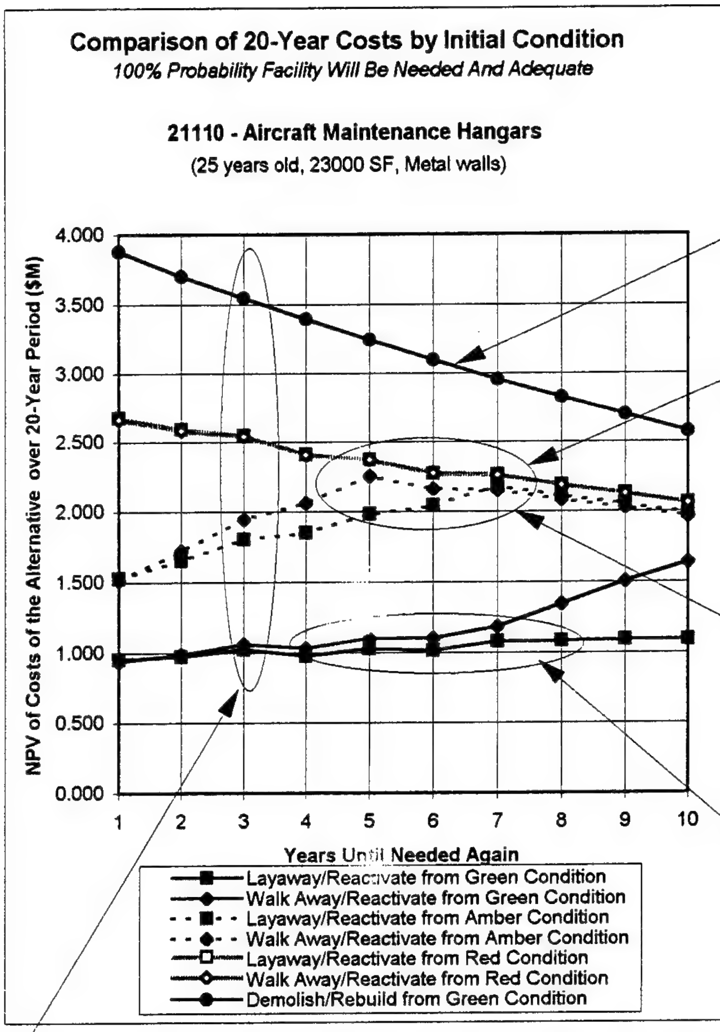
Appendix A: Notes on Analysis Results

Figure A-1. Notes on Analysis Results, Case 1

This graph represents the baseline case for the alternatives when the probabilities that the facility will be needed again and that it will be adequate are both 100%. This shows how the net present value of the costs of the alternatives vary by the length of the inactive period and by the condition of the facility at the beginning of the 20-year period over which costs are accumulated.



The demolish/rebuild alternative has the highest NPV of all for every facility type. The trend as the length of the inactive period increases is to decline because no new costs are incurred during the inactive period and the rebuild cost is postponed.

The NPV of costs for layaway and walk away in "red" condition are declining primarily because of discounting.

The peaks at 5 and 7 years for the "amber" condition result from the study assumption about deterioration rates. The peaks represents reaching a "red" condition.

The graphs are "bumpy" in the left portion of this area because the major replacement costs vary quite a bit during this period and they are accumulated at the renovation point. The walk away alternative reaches "amber" at year 7 and begins an accelerated deterioration.

The seven data points in this region represent the NPV of expected costs for each alternative when the facility is reactivated/rebuilt in three years. Demolish/rebuild is independent of initial condition. The other six points are the NPV of expected costs for layaway and walk away for three different initial conditions–red, amber, and

Figure A-2. Notes on Analysis Results, Case 1 (Percentages)

This graph indicates the percentage of the net present value of the cost of the demolish/rebuild alternative that is required for each of the other two alternatives according to the initial condition of the inactive facility. These graphs indicate the strong dependence of the costs of the layaway and walkaway alternatives on the rate of deterioration and the associated restoration/renovation costs.

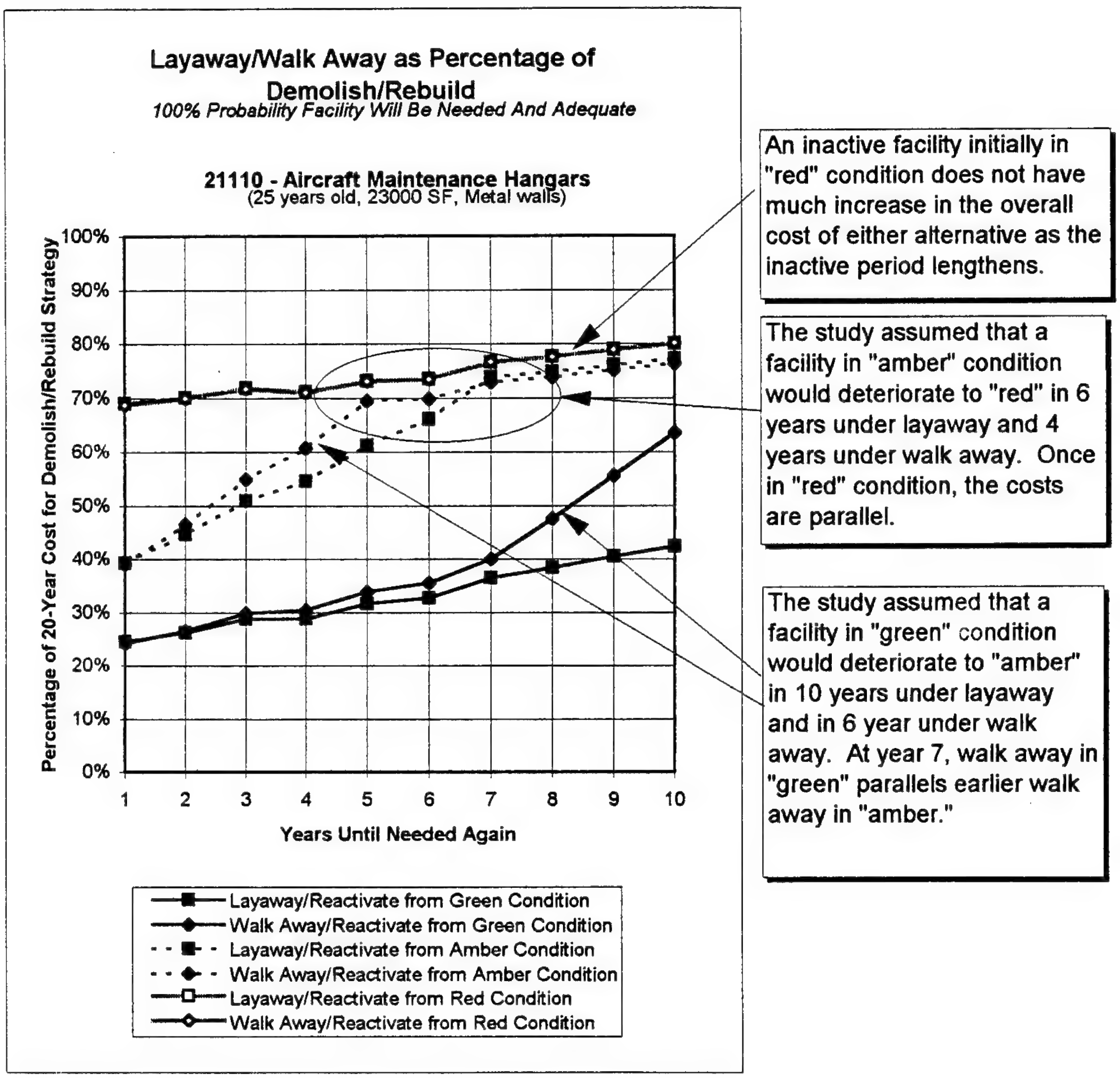


Figure A-3. Notes on Analysis Results, Case 2

This graph indicates the NPV of the cost of each alternative in the situation where an excess facility is not needed again, though this may not be known at the initial decision point. This graph indicates the relative NPV of costs for the three alternatives as a function of the length of time that passes before the inactive facility is finally demolished.

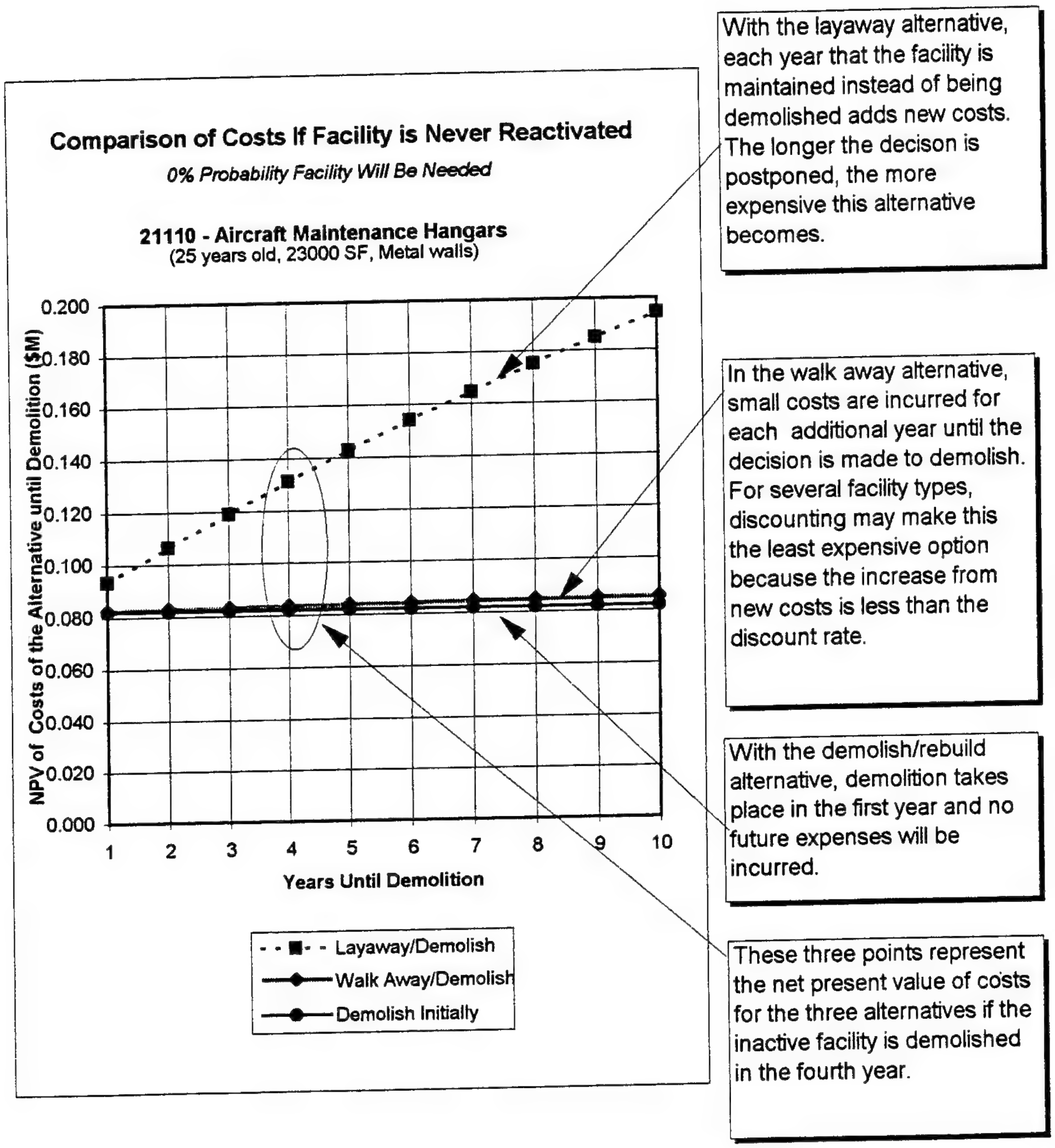


Figure A-4. Notes on Analysis Results, Case 3

This graph represents the sensitivity of the analysis to the uncertainty that the facility will be needed again or that it will be adequate, assuming that the facility has no environmental problems.

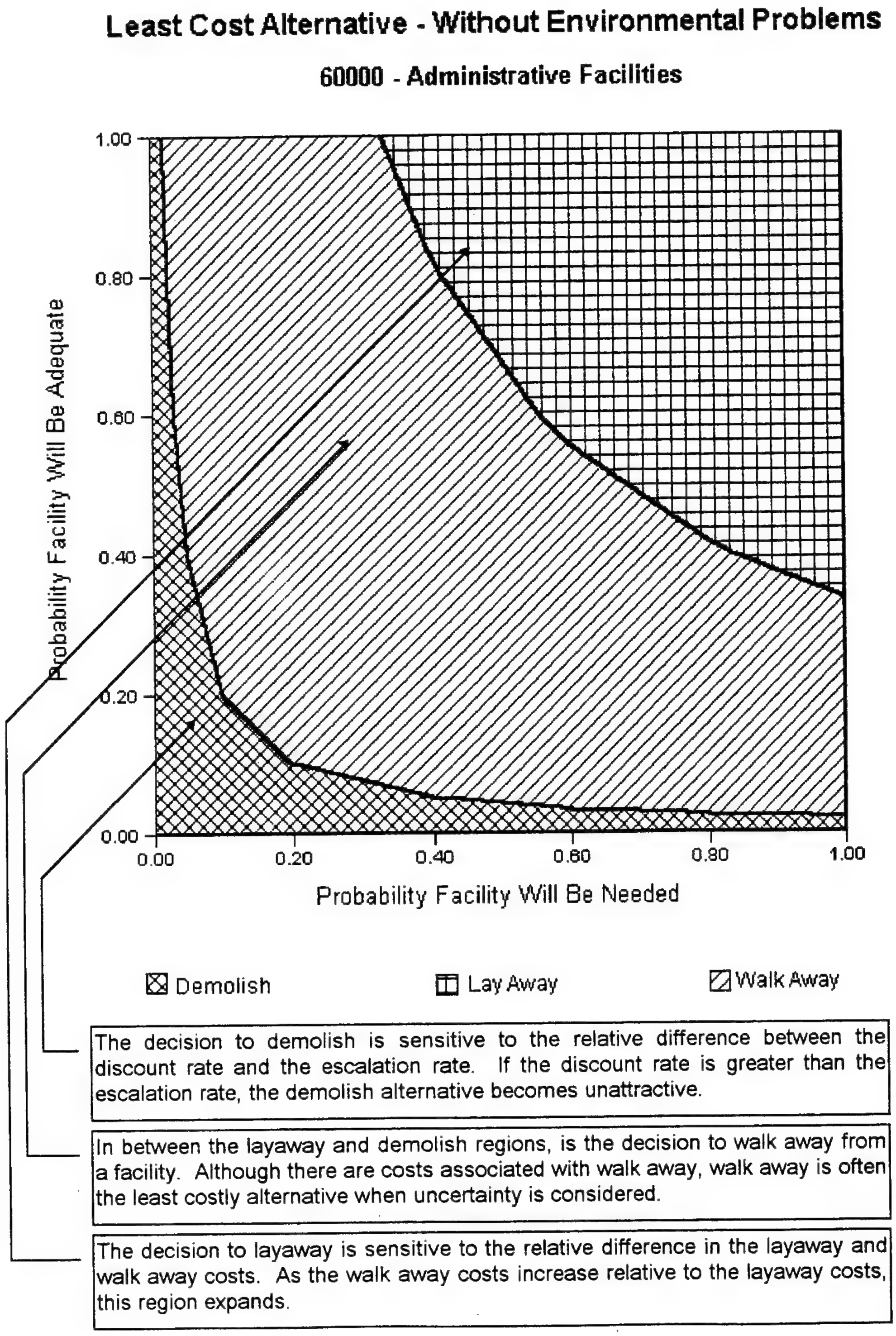
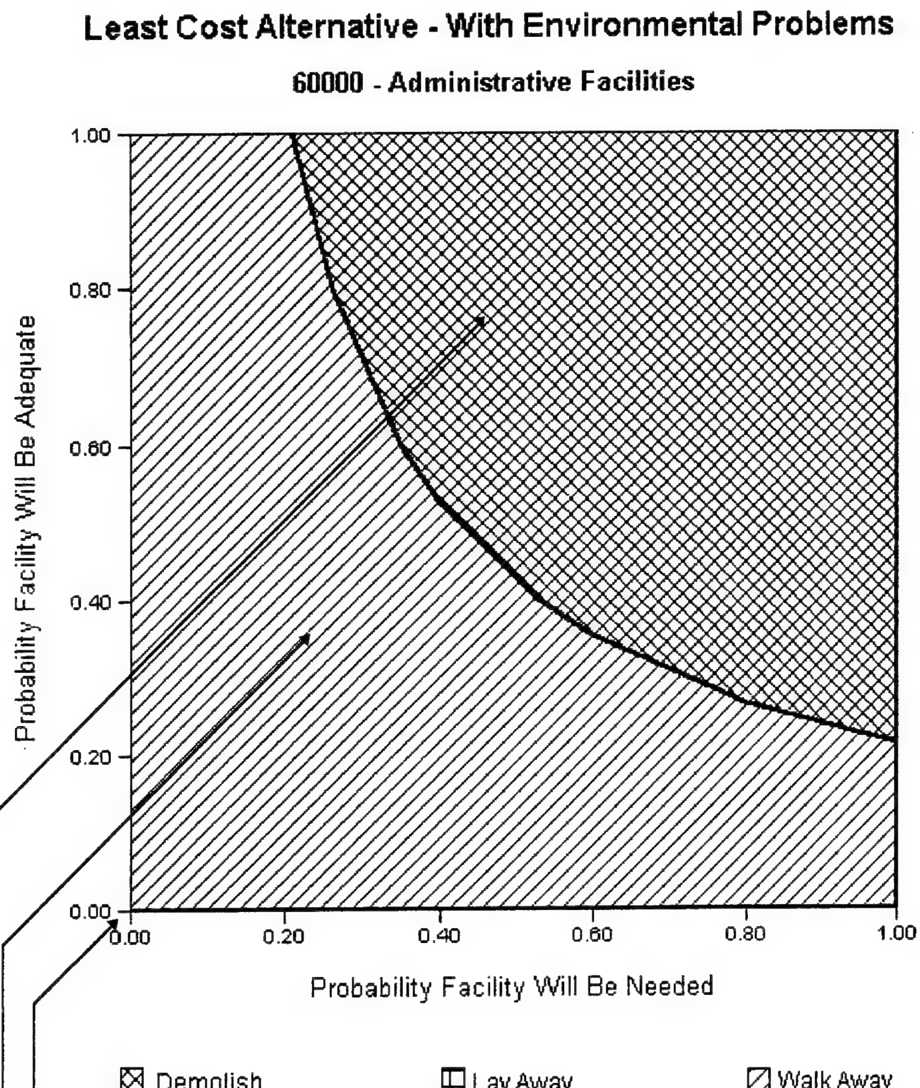


Figure A-5. Notes on Analysis Results, Case 4

This graph represents the sensitivity of the analysis to the uncertainty that the facility will be needed again or that it will be adequate assuming the facility has environmental problems the cost of which increases by five times the present cost.



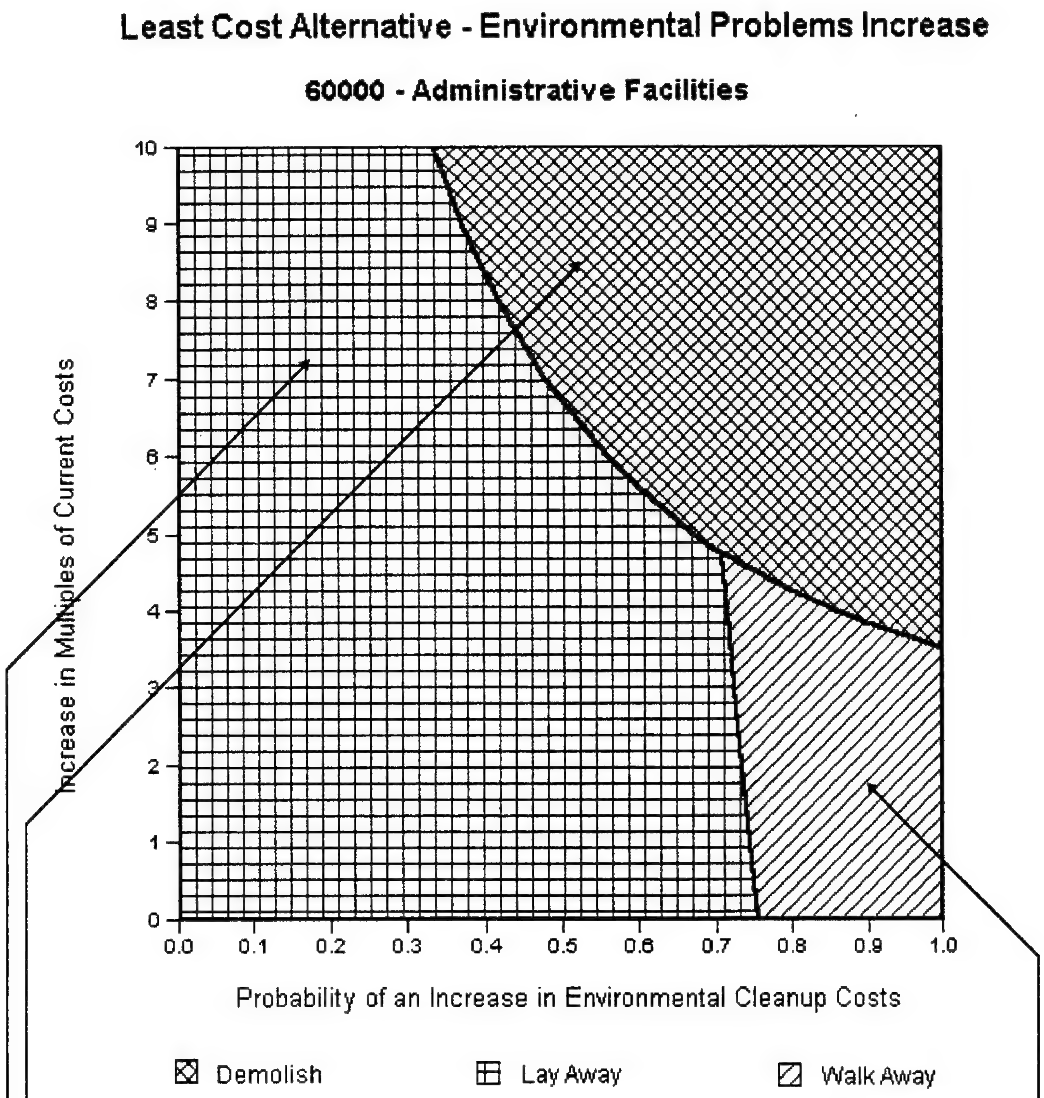
For this scenario, the layaway alternative is the least attractive. The more certain it is that the facility will be needed, the more advantageous it is to take care of the environmental problem now. As uncertainty grows, better to postpone as many expenses as possible, especially with discounting.

The reduction in cost due to discounting combined with the savings from reduced maintenance costs make the walk away alternative attractive, especially if it is uncertain the facility will be needed again or that it will be adequate.

The alternative to demolish now becomes increasingly attractive when the cost of environmental cleanup in the future overtakes the cost of rebuilding.

Figure A-6. Notes on Analysis Results, Case 5

This graph represents the sensitivity of the analysis to the uncertainty that the cost of environmental cleanup will increase in the future and to the amount of that increase.

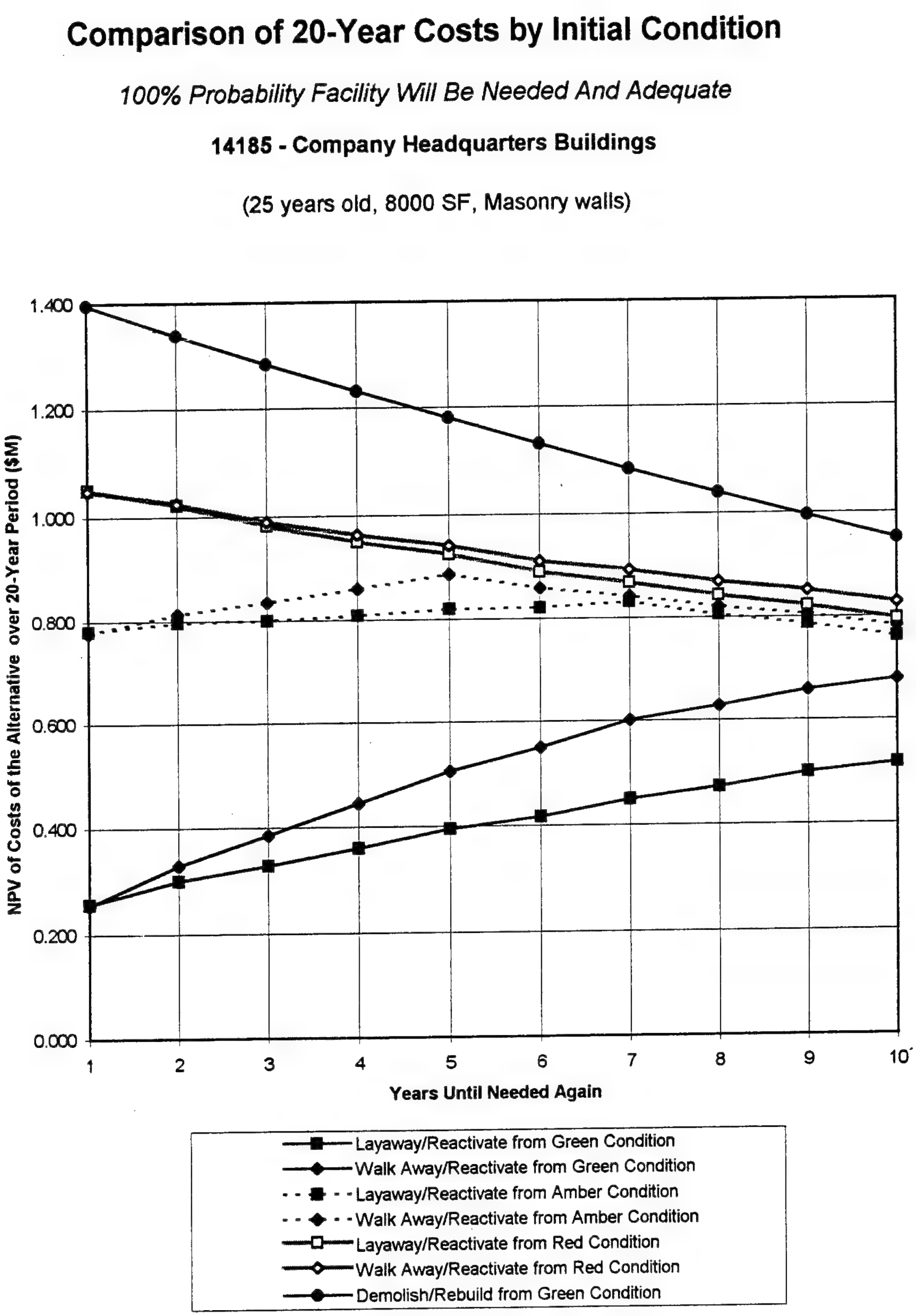


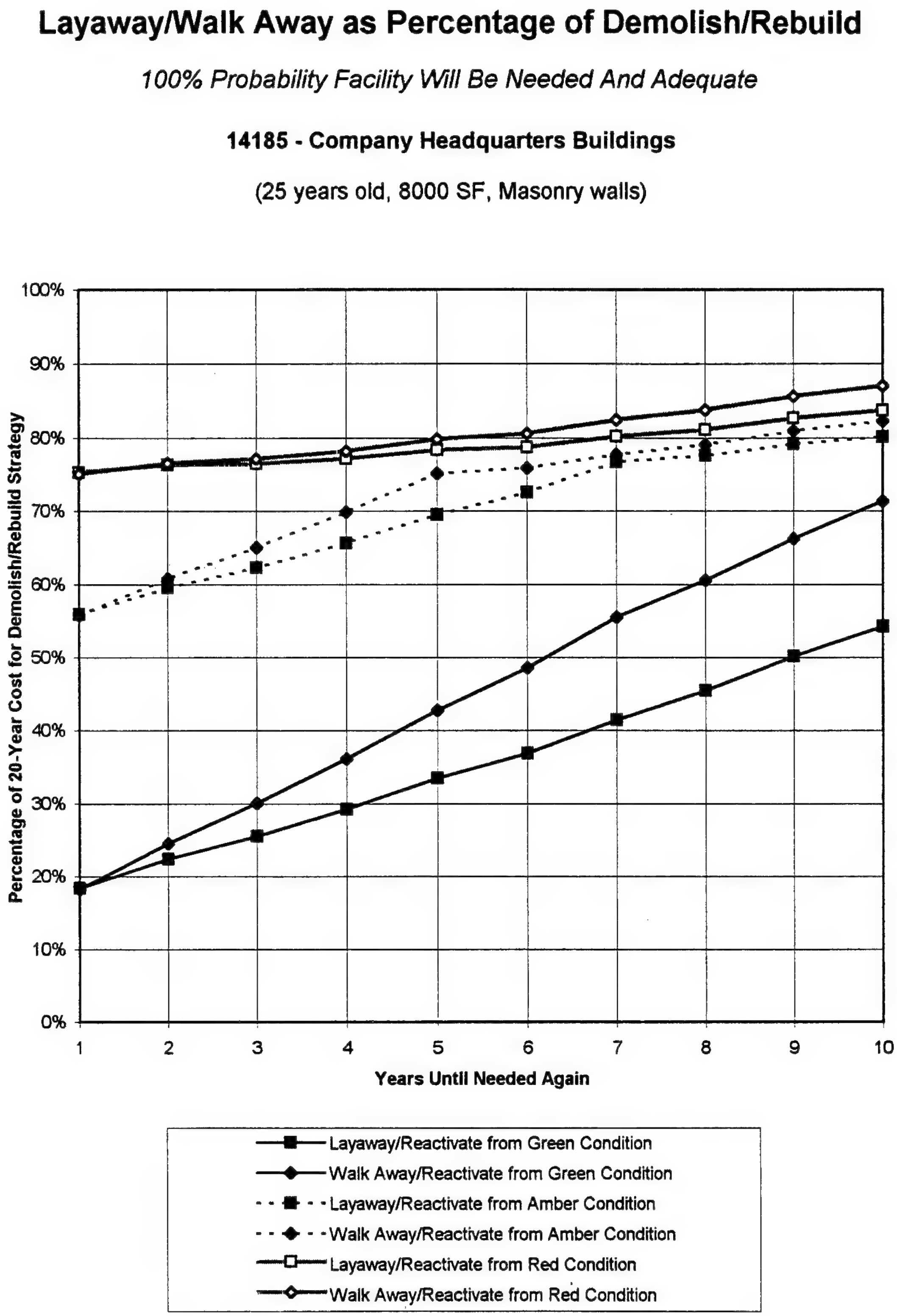
The walk away alternative is preferred when it is relatively certain that the increase will occur but the increase is not large enough to overcome the benefits of postponing the costs.

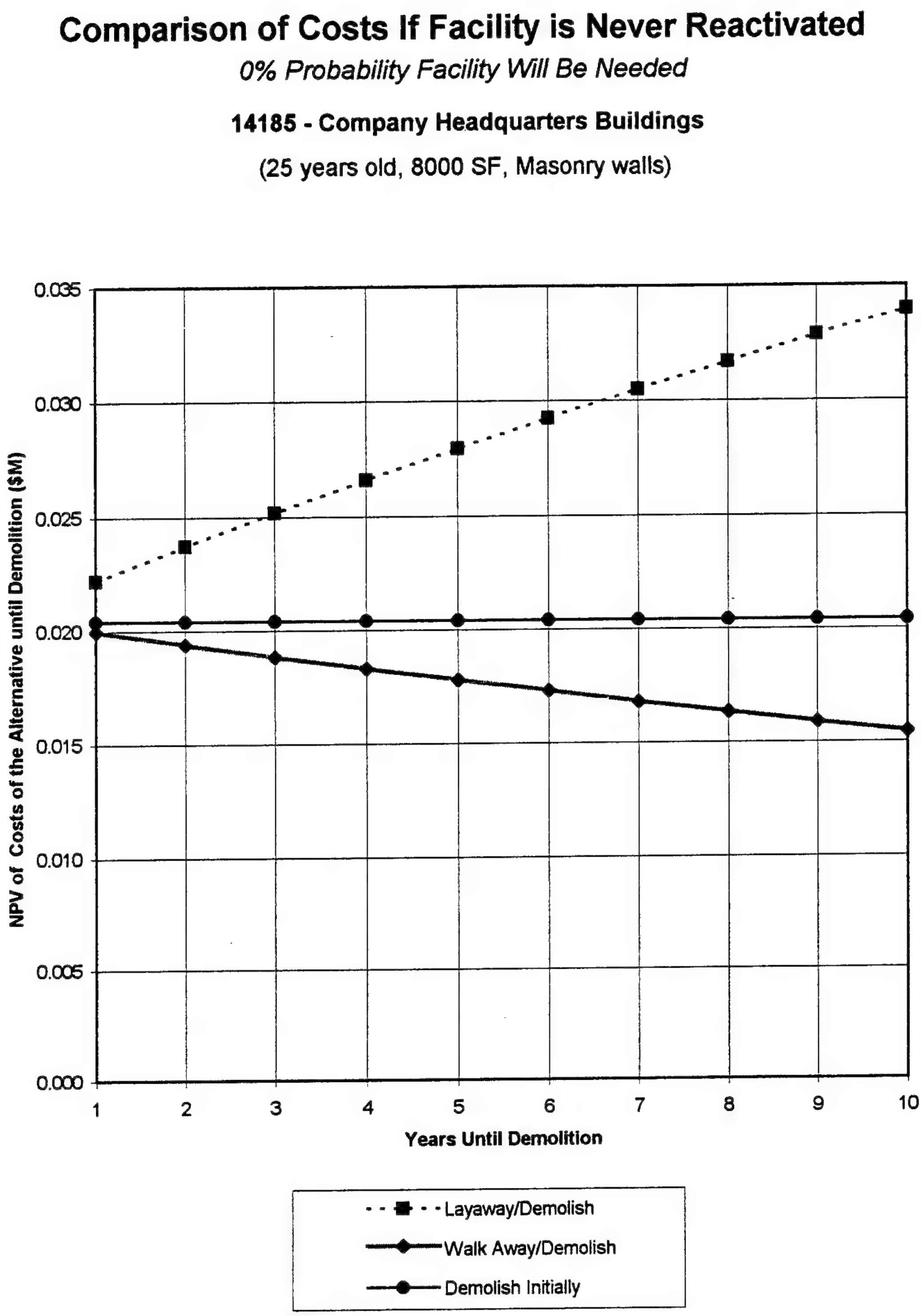
Ultimately the cost of environmental cleanup outweighs the cost to demolish now and rebuild. The point at which this happens is very dependent on the cost of renovation versus new construction.

The layaway alternative remains the least expensive option as long as the increment in environmental costs is small or the probability of the increment is small.

Appendix B: 14185—Company Headquarters Buildings

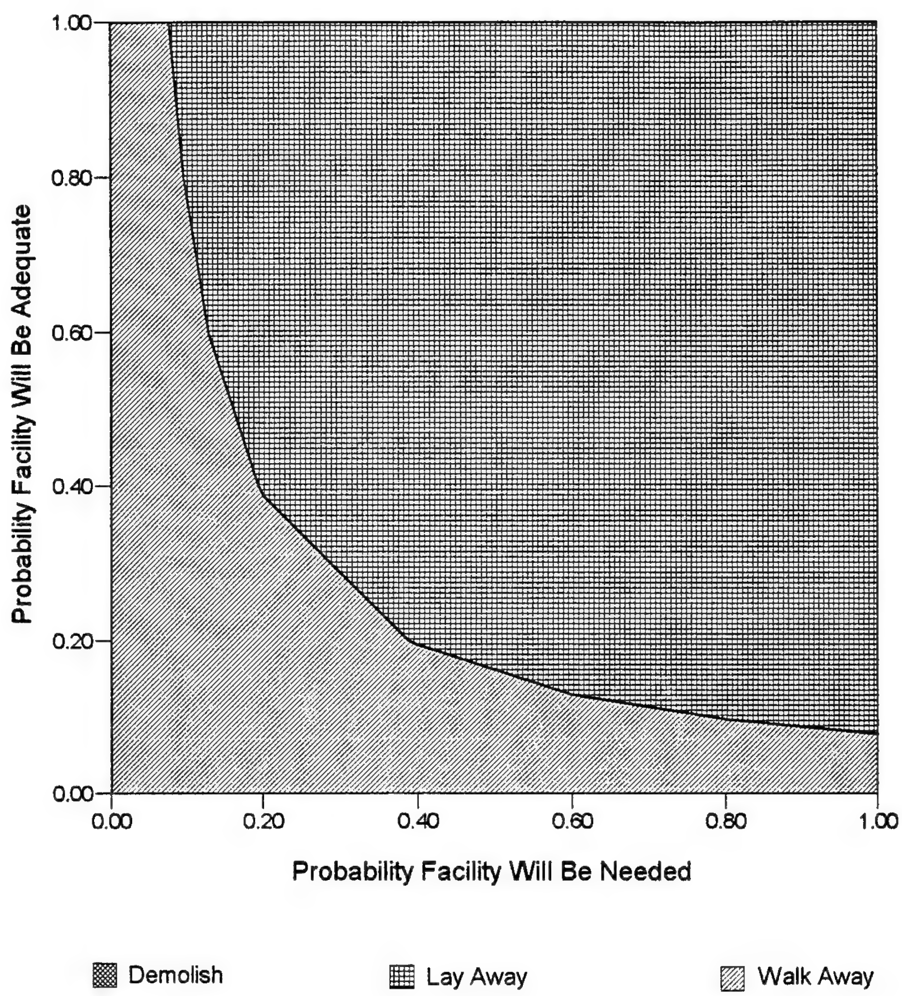

Comparison of 20-Year Costs by Initial Condition
100% Probability Facility Will Be Needed And Adequate
14185 - Company Headquarters Buildings
(25 years old, 8000 SF, Masonry walls)
1.400
1.200
1.000
0.800
0.600
0.400
0.200
0.000
NPV of Costs of the Alternative over 20-Year Period ($M)
1
2
3
4
5
6
7
8
9
10
Years Until Needed Again
Layaway/Reactivate from Green Condition
Walk Away/Reactivate from Green Condition
Layaway/Reactivate from Amber Condition
Walk Away/Reactivate from Amber Condition
Layaway/Reactivate from Red Condition
Walk Away/Reactivate from Red Condition
Demolish/Rebuild from Green Condition

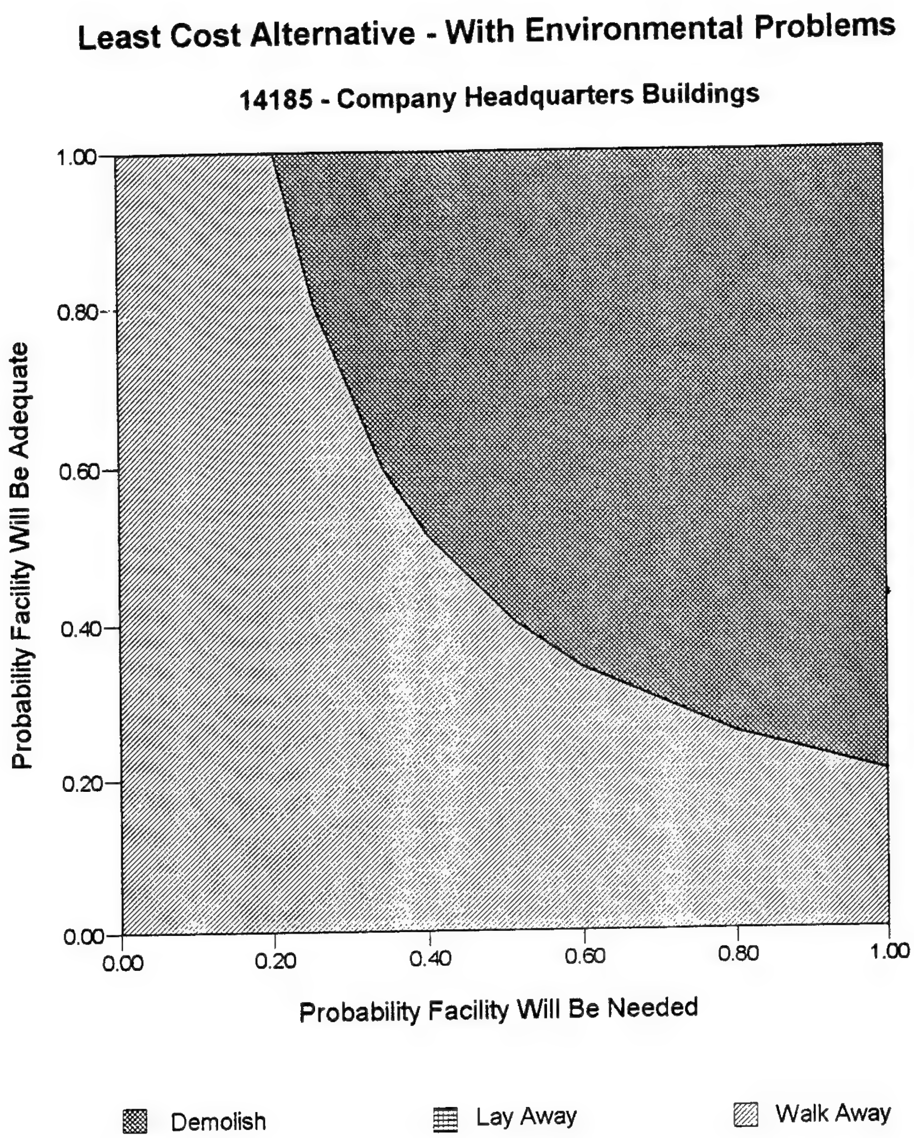

Layaway/Walk Away as Percentage of Demolish/Rebuild
100% Probability Facility Will Be Needed And Adequate
14185 - Company Headquarters Buildings
(25 years old, 8000 SF, Masonry walls)
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Percentage of 20-Year Cost for Demolish/Rebuild Strategy
1
2
3
4
5
6
7
8
9
10
Years Until Needed Again
Layaway/Reactivate from Green Condition
Walk Away/Reactivate from Green Condition
Layaway/Reactivate from Amber Condition
Walk Away/Reactivate from Amber Condition
Layaway/Reactivate from Red Condition
Walk Away/Reactivate from Red Condition

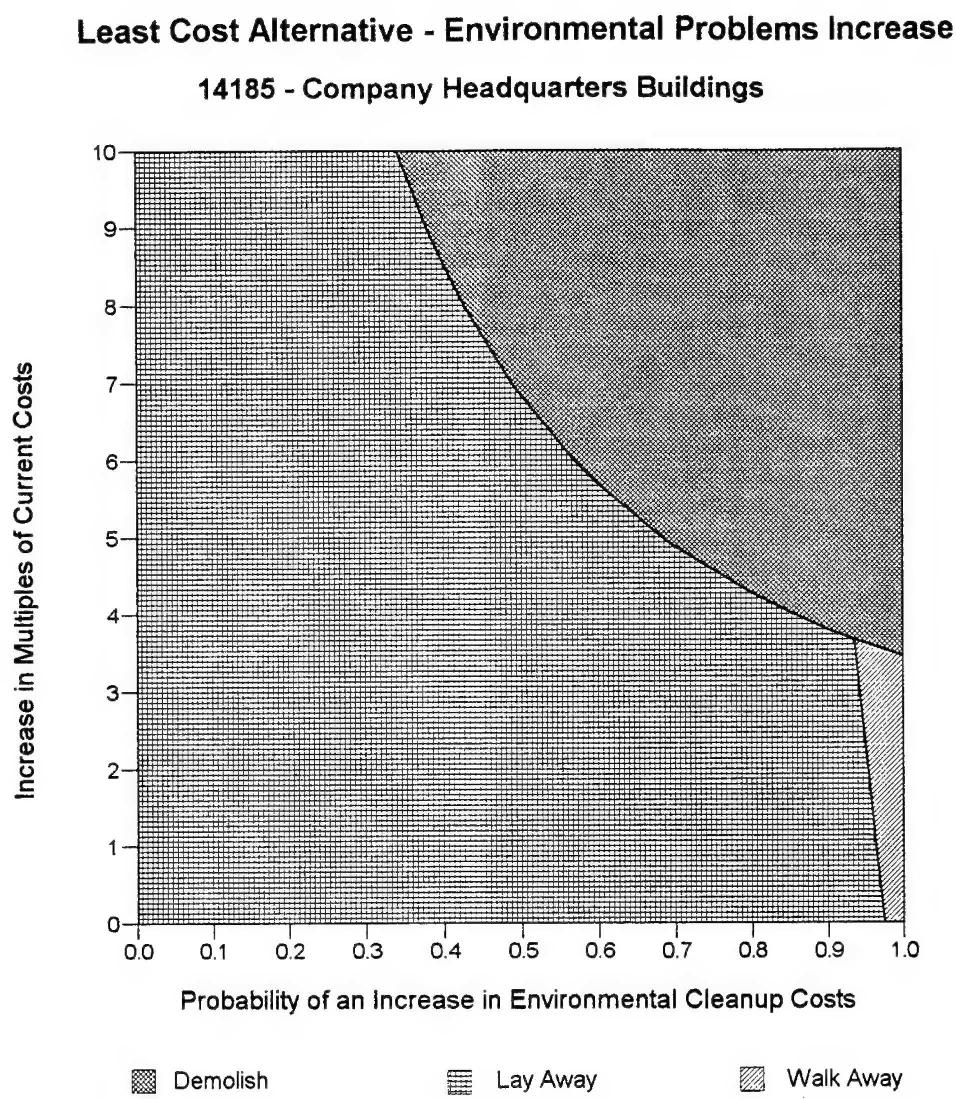

Comparison of Costs If Facility is Never Reactivated
0% Probability Facility Will Be Needed
14185 - Company Headquarters Buildings
(25 years old, 8000 SF, Masonry walls)
0.035
0.030
0.025
0.020
0.015
0.010
0.005
0.000
NPV of Costs of the Alternative until Demolition ($M)
1
2
3
4
5
6
7
8
9
10
Years Until Demolition
Layaway/Demolish
Walk Away/Demolish
Demolish Initially

Least Cost Alternative - Without Environmental Problems

14185 - Company Headquarters Buildings




Least Cost Alternative - With Environmental Problems
14185 - Company Headquarters Buildings
Probability Facility Will Be Adequate
1.00
0.80
0.60
0.40
0.20
0.00
0.00
0.20
0.40
0.60
0.80
1.00
Probability Facility Will Be Needed
Demolish
Lay Away
Walk Away


Least Cost Alternative - Environmental Problems Increase
14185 - Company Headquarters Buildings
Increase in Multiples of Current Costs
0
1
2
3
4
5
6
7
8
9
10
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
Probability of an Increase in Environmental Cleanup Costs
Demolish
Lay Away
Walk Away

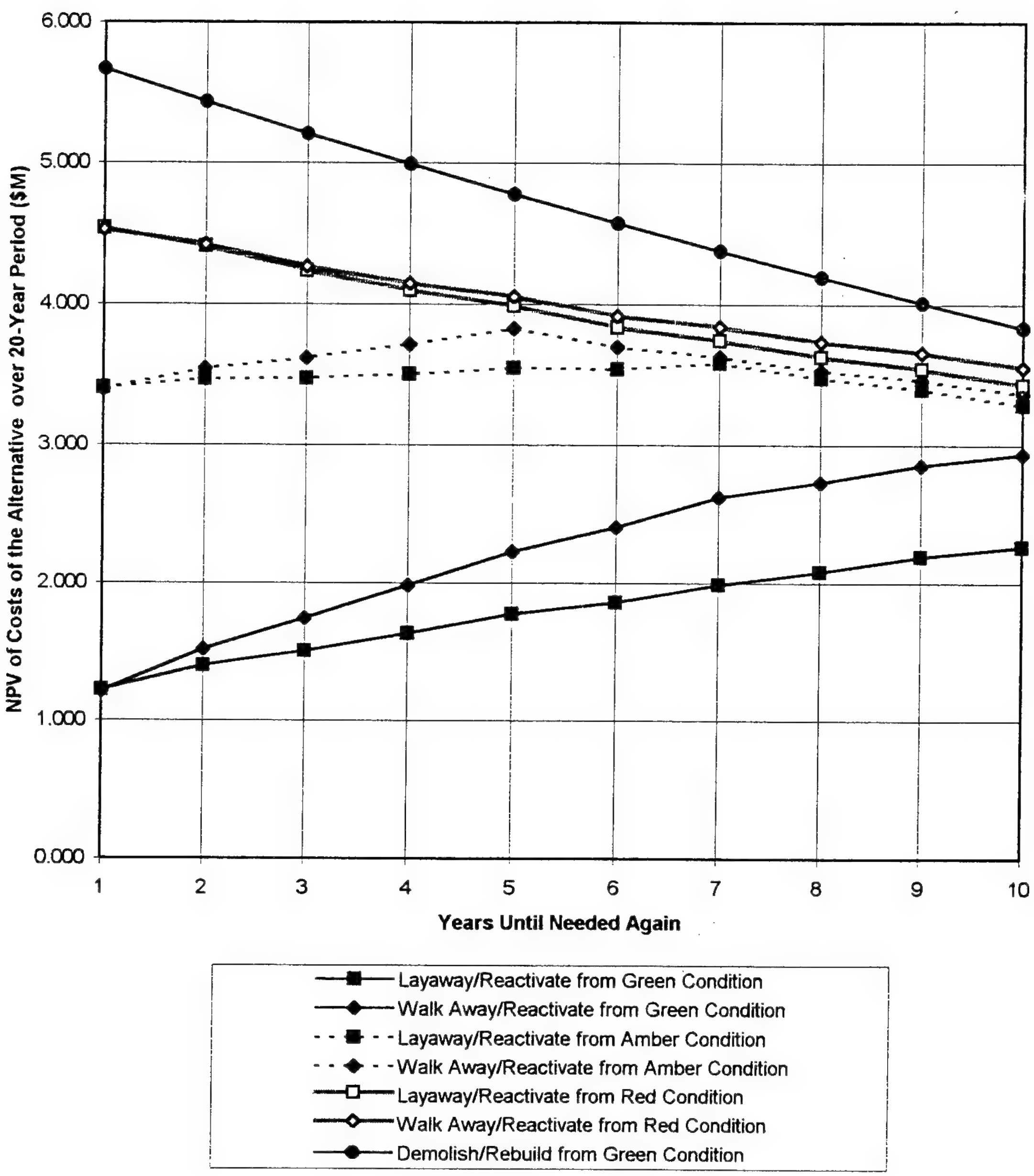
Appendix C: 17120—General Instruction Buildings

Comparison of 20-Year Costs by Initial Condition

100% Probability Facility Will Be Needed And Adequate

17120 - General Instruction Buildings

(25 years old, 38000 SF, Masonry walls)

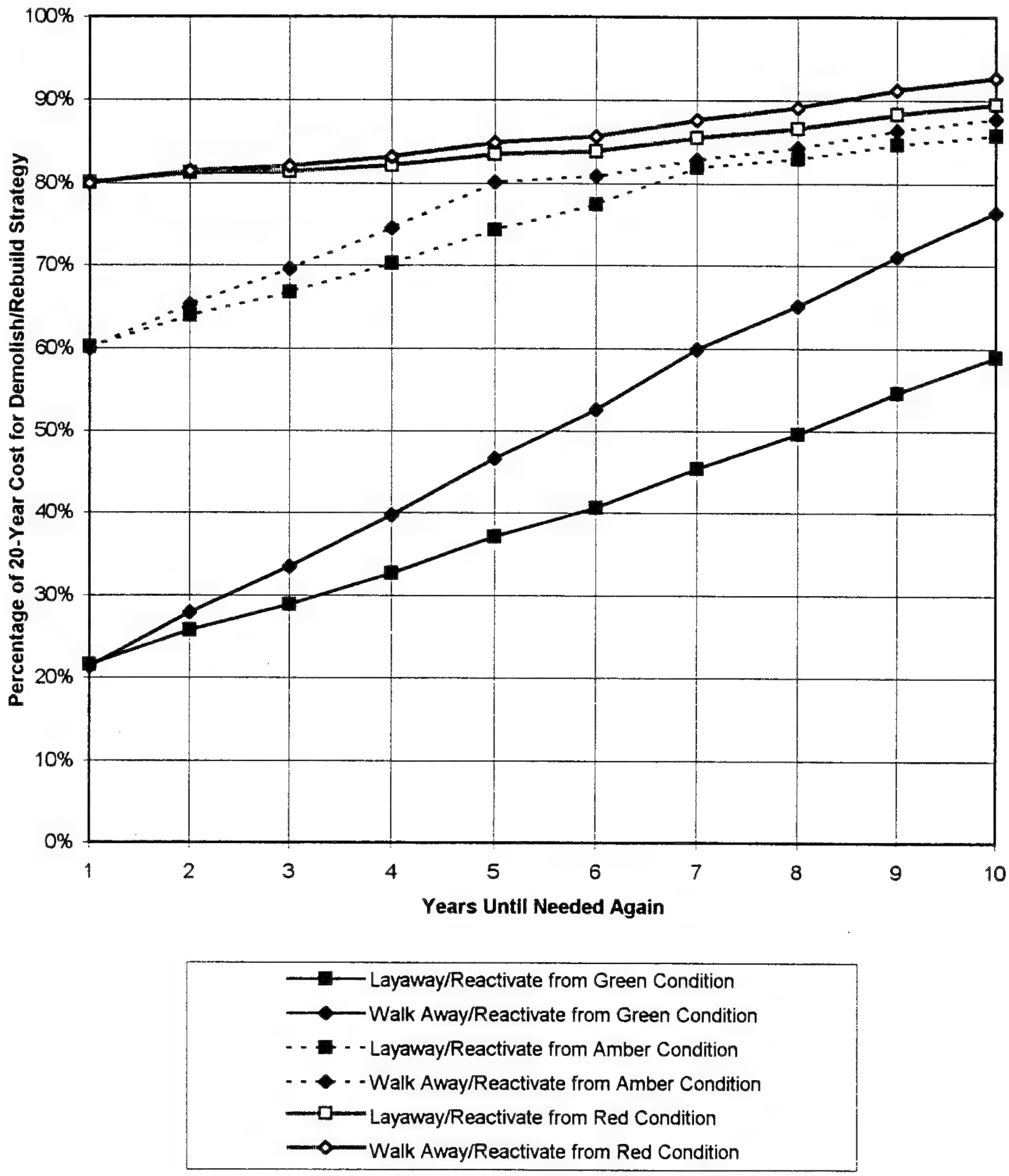


Layaway/Walk Away as Percentage of Demolish/Rebuild

100% Probability Facility Will Be Needed And Adequate

17120 - General Instruction Buildings

(25 years old, 38000 SF, Masonry walls)

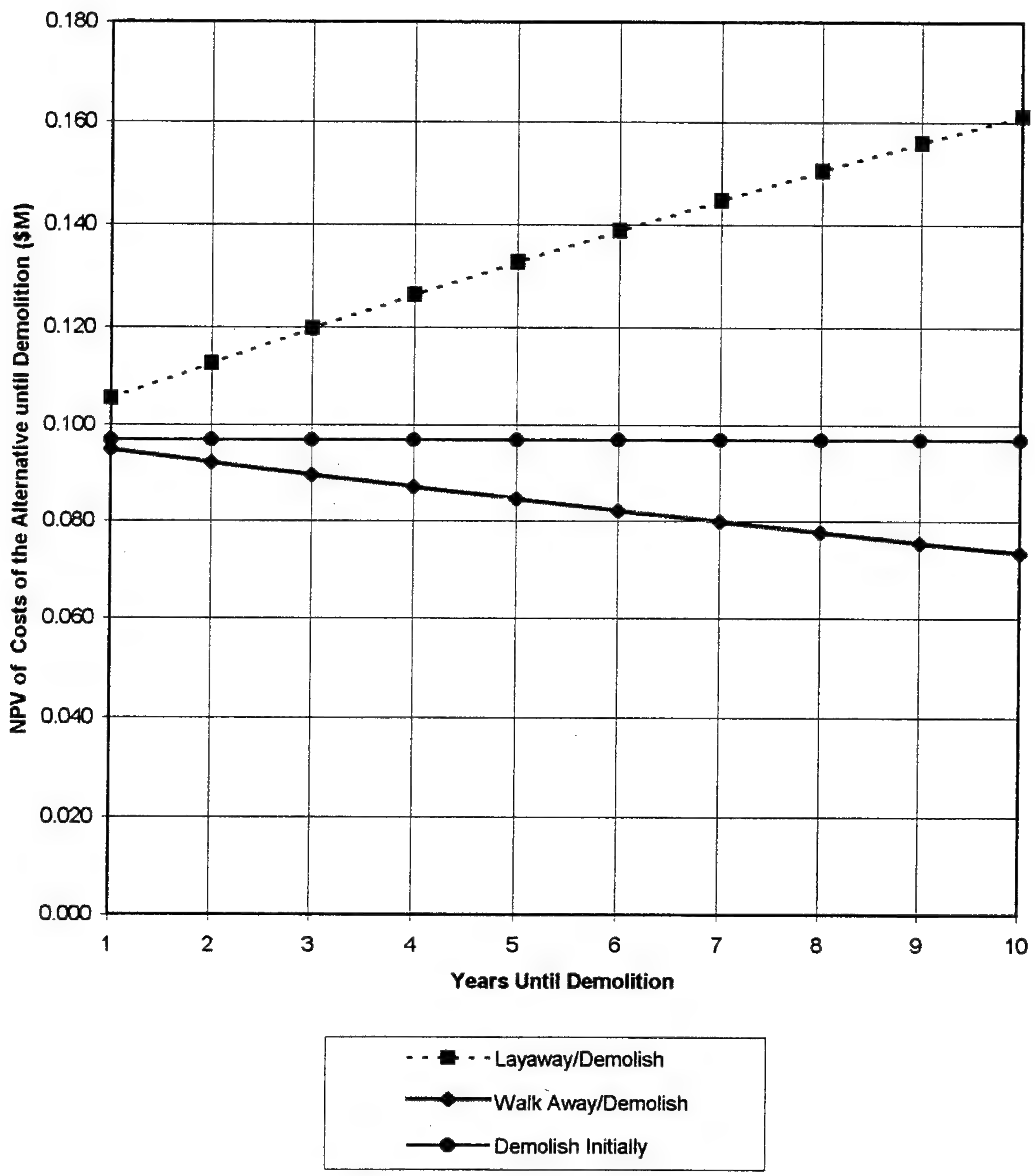


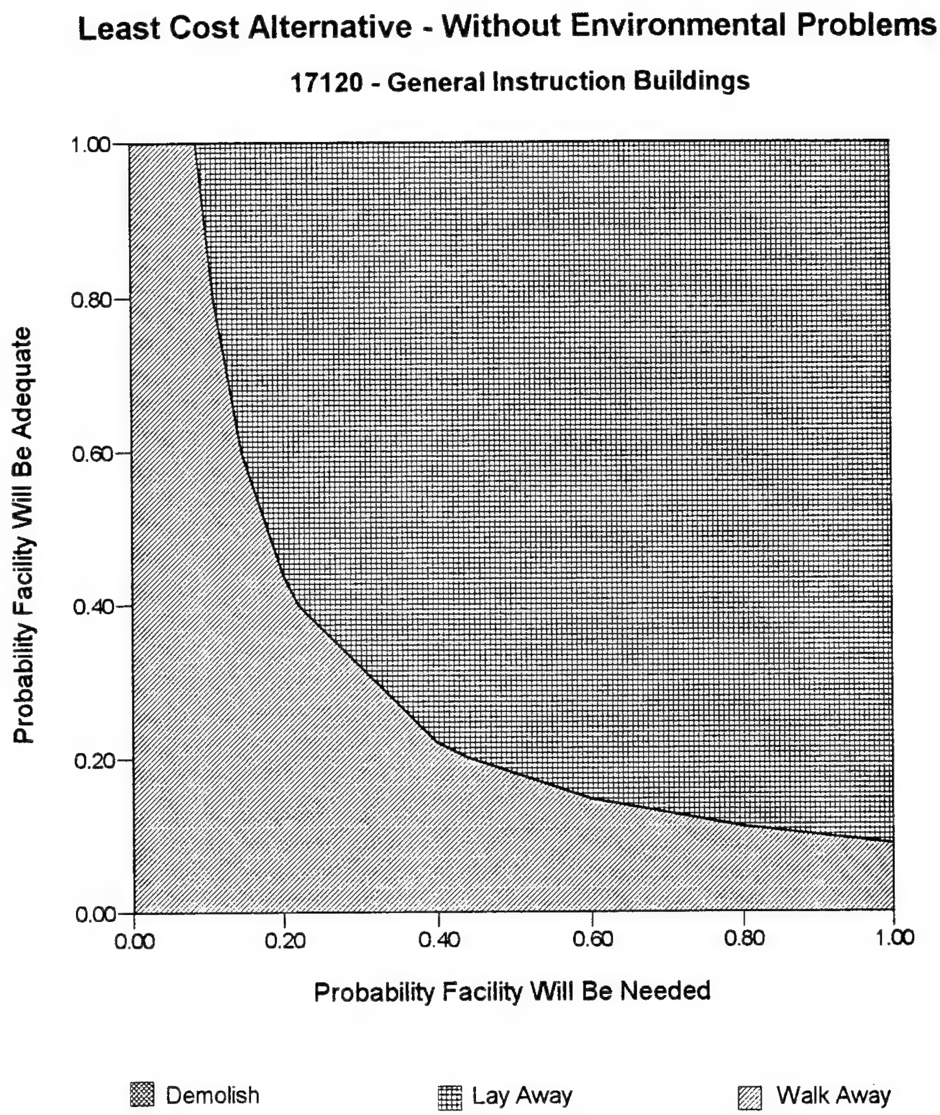
Comparison of Costs If Facility is Never Reactivated

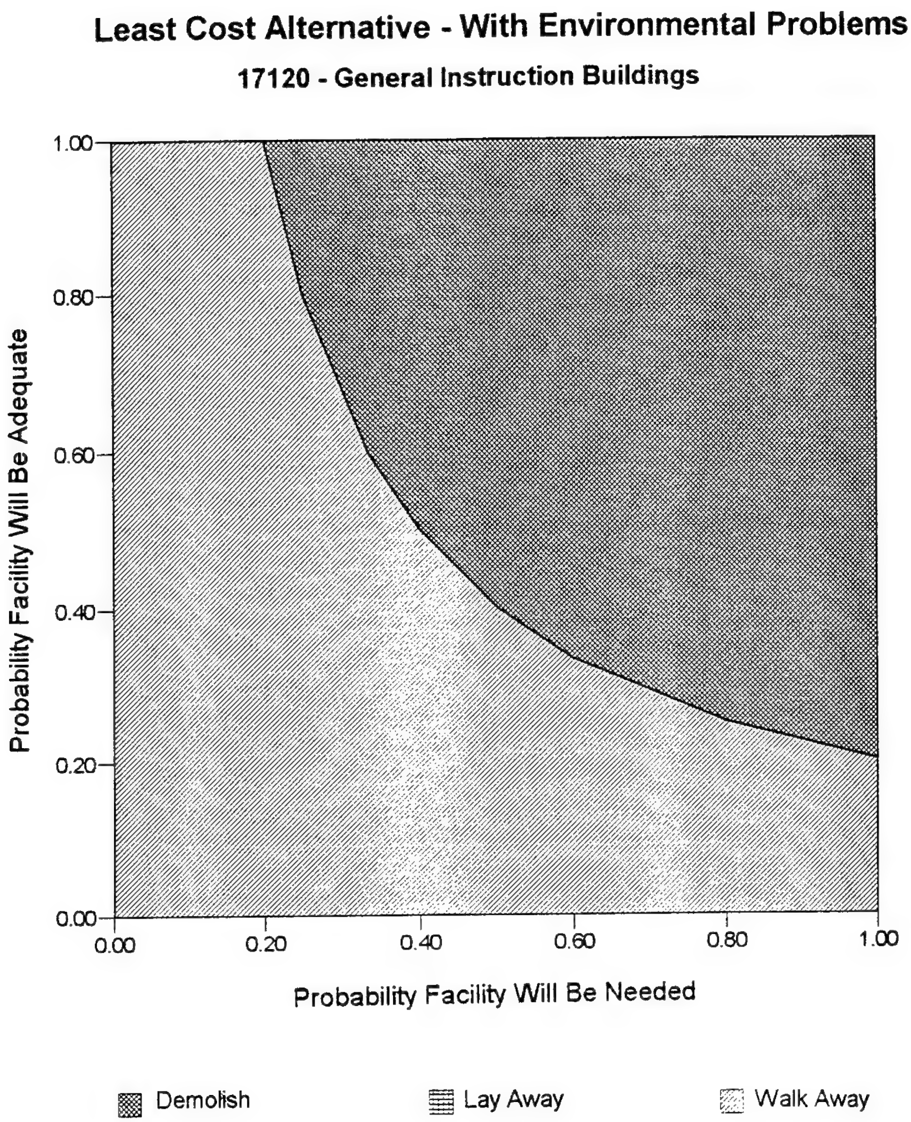
0% Probability Facility Will Be Needed

17120 - General Instruction Buildings

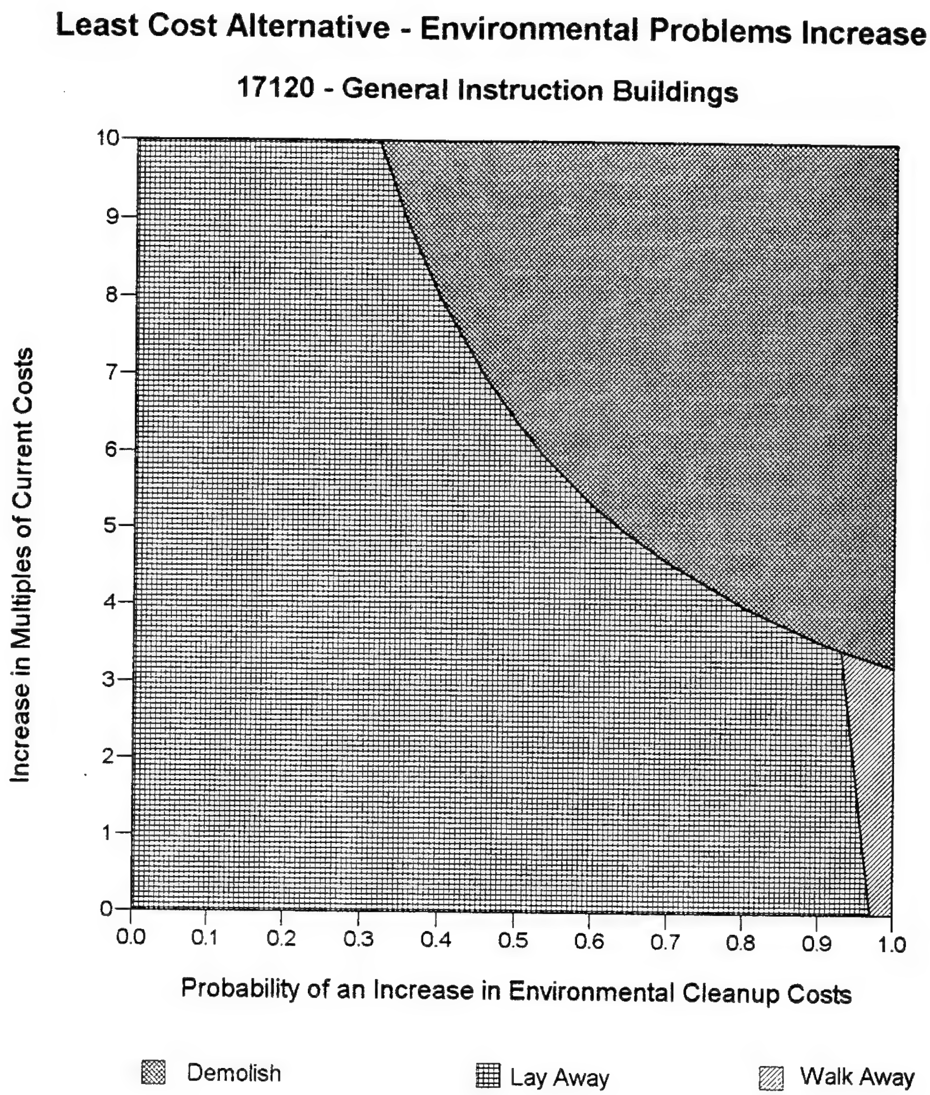
(25 years old, 38000 SF, Masonry walls)




Least Cost Alternative - Without Environmental Problems
17120 - General Instruction Buildings
1.00
0.80
0.60
0.40
0.20
0.00
Probability Facility Will Be Adequate
0.00
0.20
0.40
0.60
0.80
1.00
Probability Facility Will Be Needed
Demolish
Lay Away
Walk Away



Least Cost Alternative - With Environmental Problems
17120 - General Instruction Buildings
Probability Facility Will Be Adequate
1.00
0.80
0.60
0.40
0.20
0.00
0.00
0.20
0.40
0.60
0.80
1.00
Probability Facility Will Be Needed
Demolish
Lay Away
Walk Away



Least Cost Alternative - Environmental Problems Increase
17120 - General Instruction Buildings
10
9
8
7
6
5
4
3
2
1
0
Increase in Multiples of Current Costs
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
Probability of an Increase in Environmental Cleanup Costs
Demolish
Lay Away
Walk Away

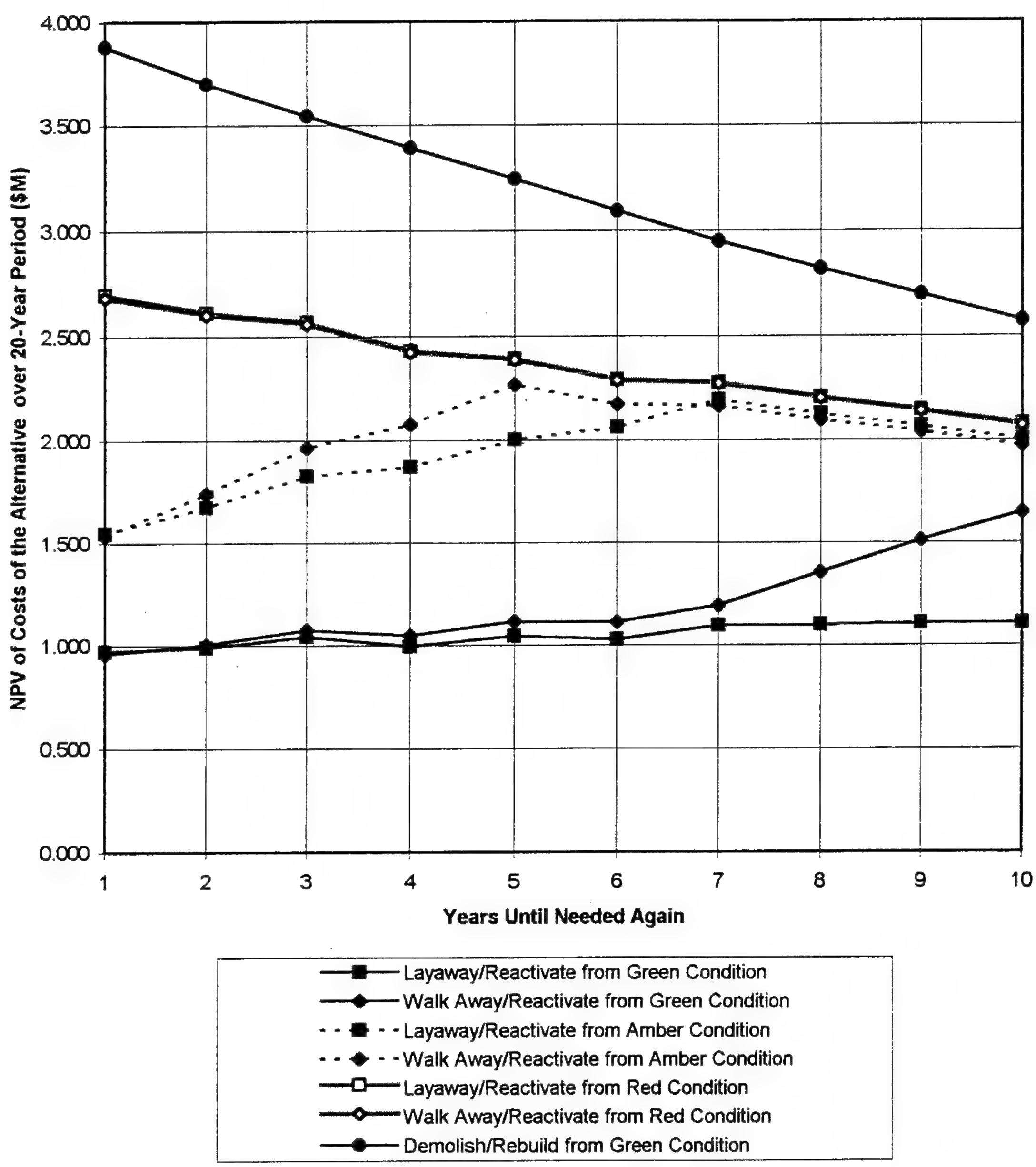
Appendix D: 21110—Aircraft Maintenance Hangars

Comparison of 20-Year Costs by Initial Condition

100% Probability Facility Will Be Needed And Adequate

21110 - Aircraft Maintenance Hangers

(25 years old, 23000 SF, Metal walls)

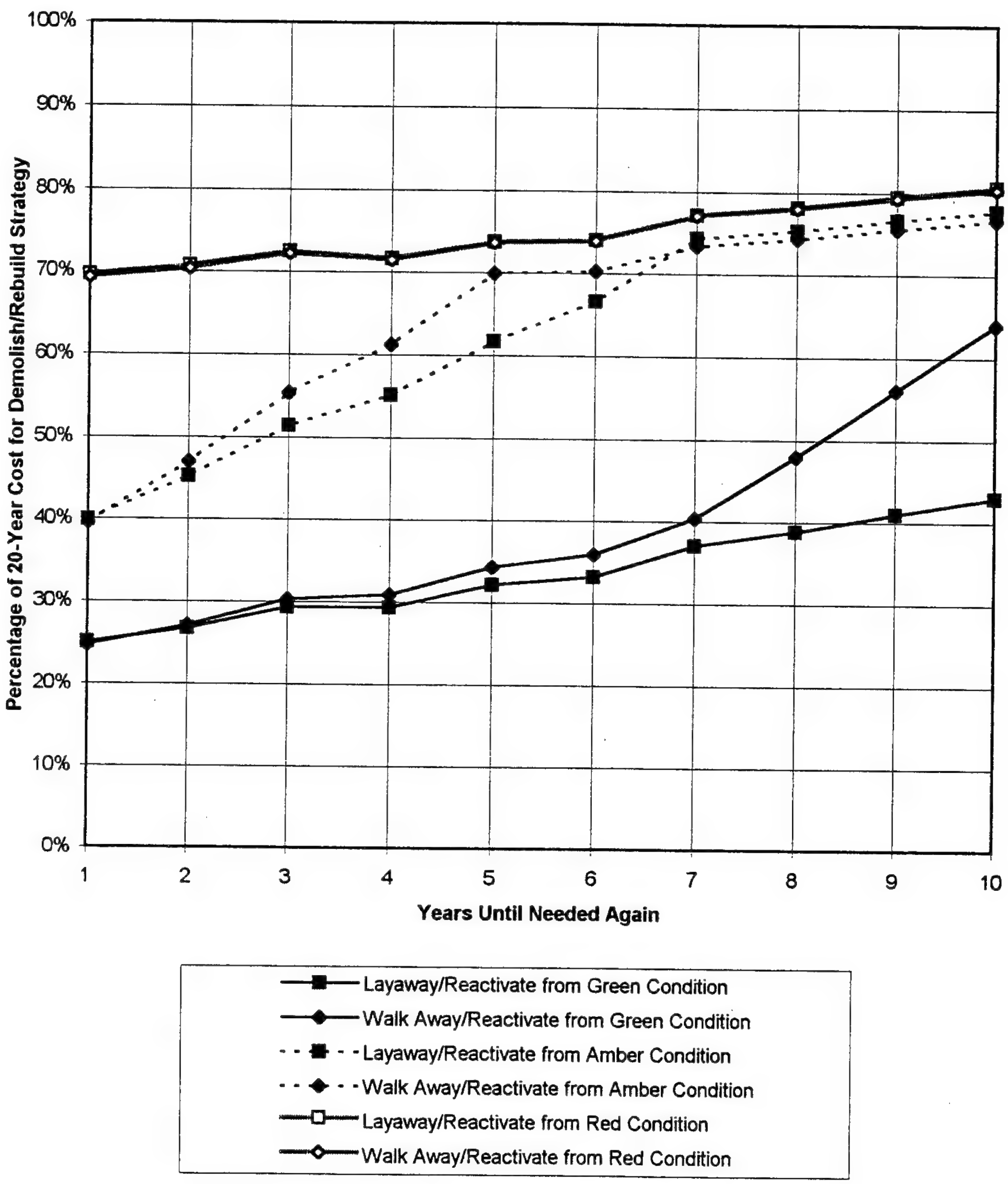


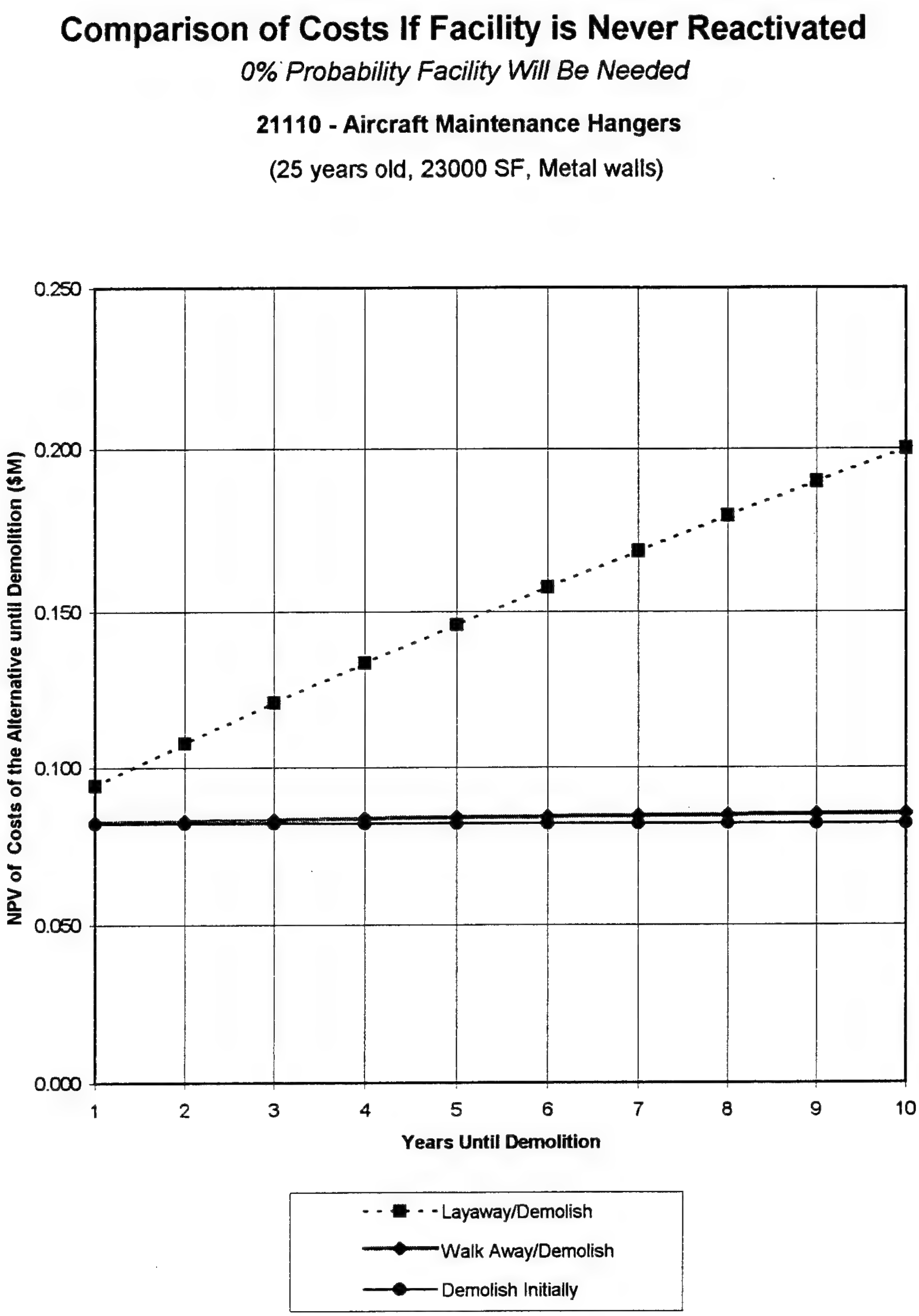
Layaway/Walk Away as Percentage of Demolish/Rebuild

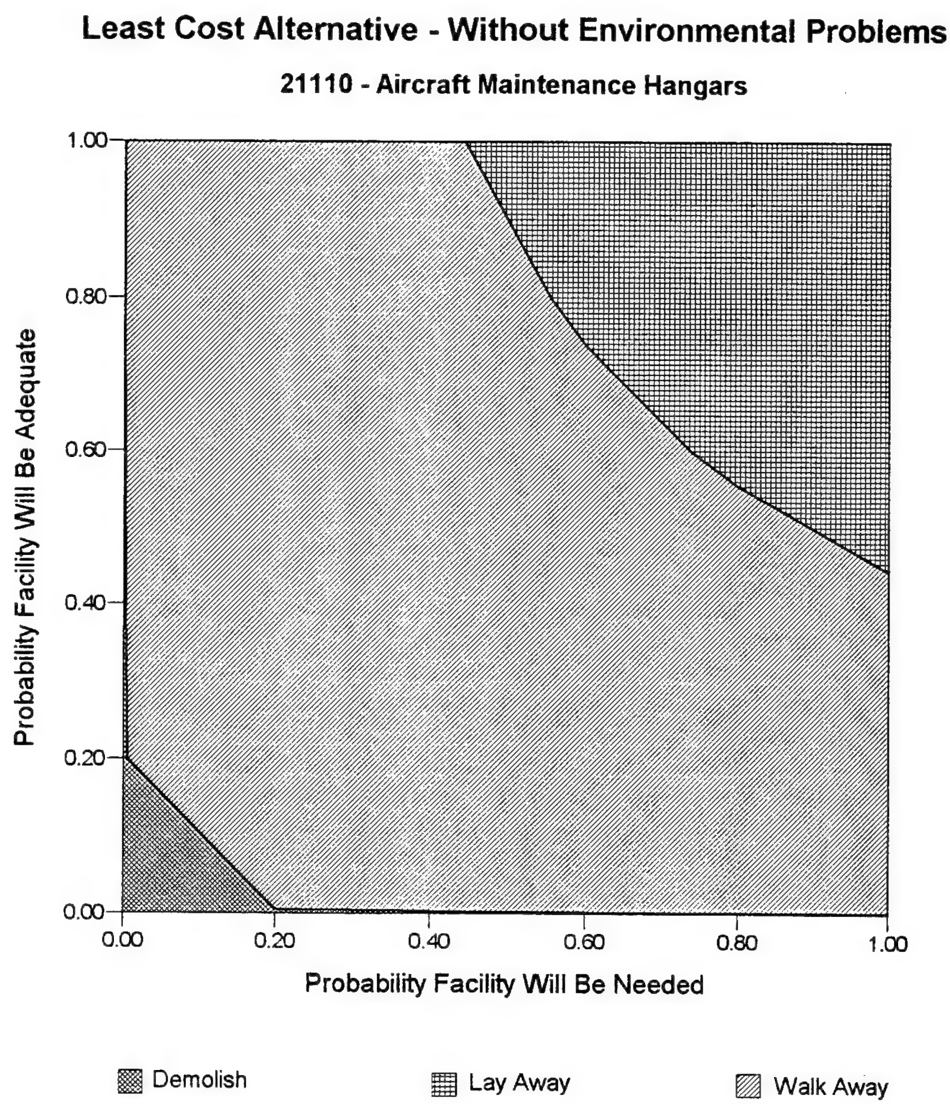
100% Probability Facility Will Be Needed And Adequate

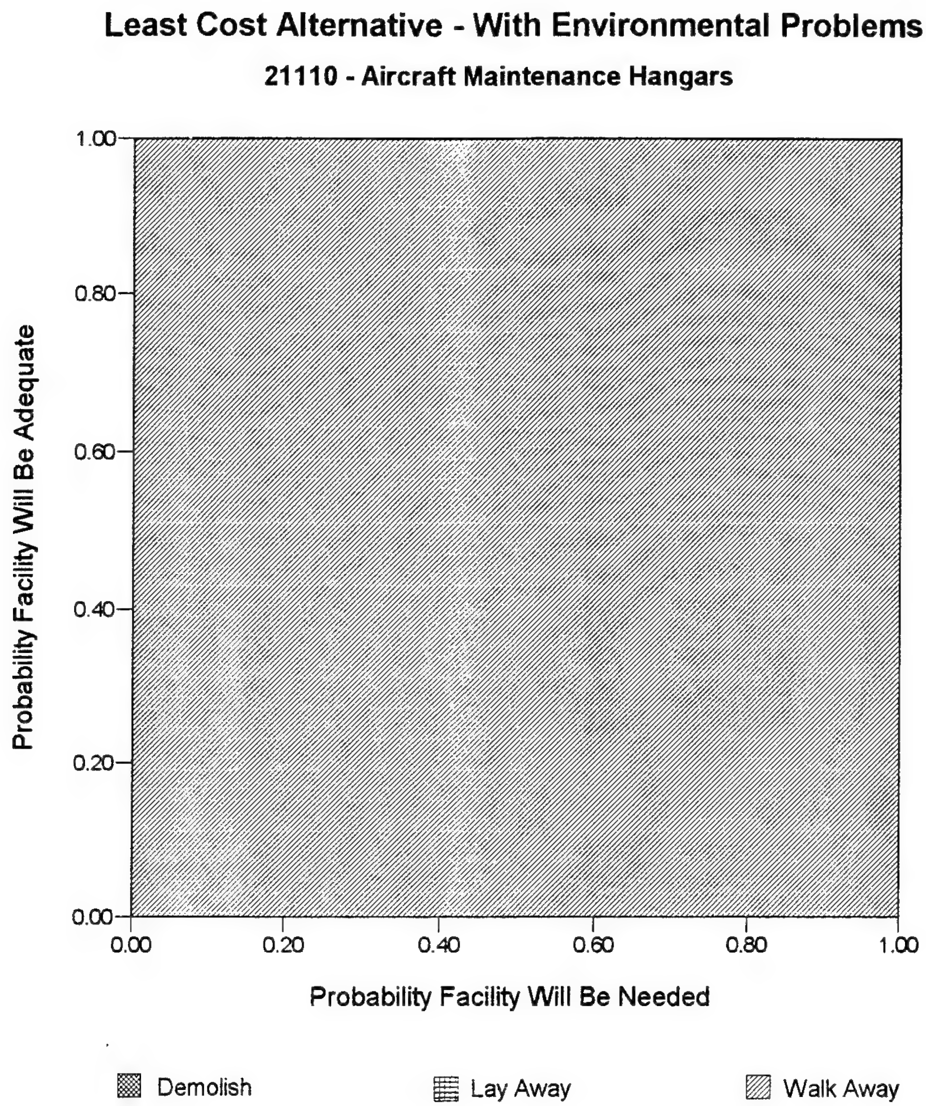
21110 - Aircraft Maintenance Hangers

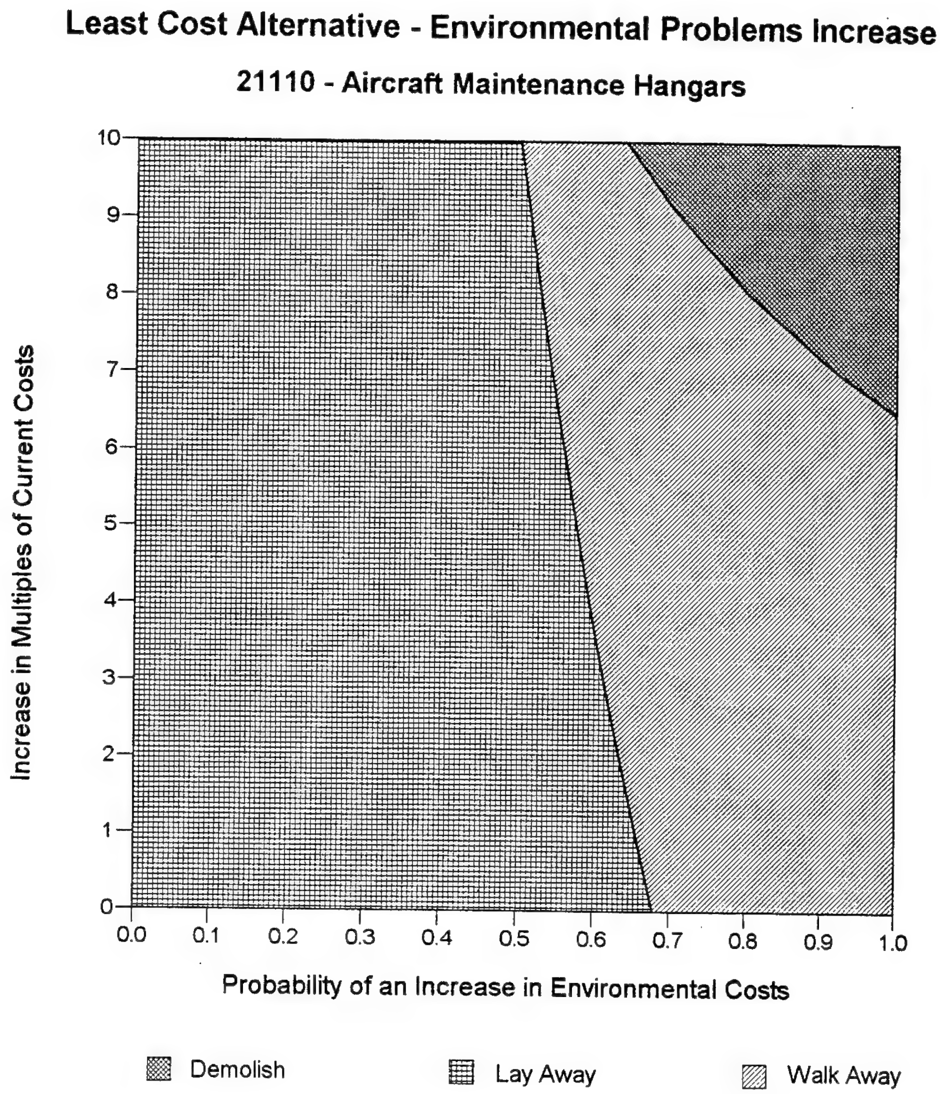
(25 years old, 23000 SF, Metal walls)




Comparison of Costs If Facility is Never Reactivated
0% Probability Facility Will Be Needed
21110 - Aircraft Maintenance Hangers
(25 years old, 23000 SF, Metal walls)
0.250
0.200
0.150
0.100
0.050
0.000
NPV of Costs of the Alternative until Demolition ($M)
1
2
3
4
5
6
7
8
9
10
Years Until Demolition
Layaway/Demolish
Walk Away/Demolish
Demolish Initially


Least Cost Alternative - Without Environmental Problems
21110 - Aircraft Maintenance Hangars
1.00
0.80
0.60
0.40
0.20
0.00
Probability Facility Will Be Adequate
0.00
0.20
0.40
0.60
0.80
1.00
Probability Facility Will Be Needed
Demolish
Lay Away
Walk Away


Least Cost Alternative - With Environmental Problems
21110 - Aircraft Maintenance Hangars
1.00
0.80
0.60
0.40
0.20
0.00
Probability Facility Will Be Adequate
0.00
0.20
0.40
0.60
0.80
1.00
Probability Facility Will Be Needed
Demolish
Lay Away
Walk Away


Least Cost Alternative - Environmental Problems Increase
21110 - Aircraft Maintenance Hangars
Increase in Multiples of Current Costs
0
1
2
3
4
5
6
7
8
9
10
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
Probability of an Increase in Environmental Costs
Demolish
Lay Away
Walk Away

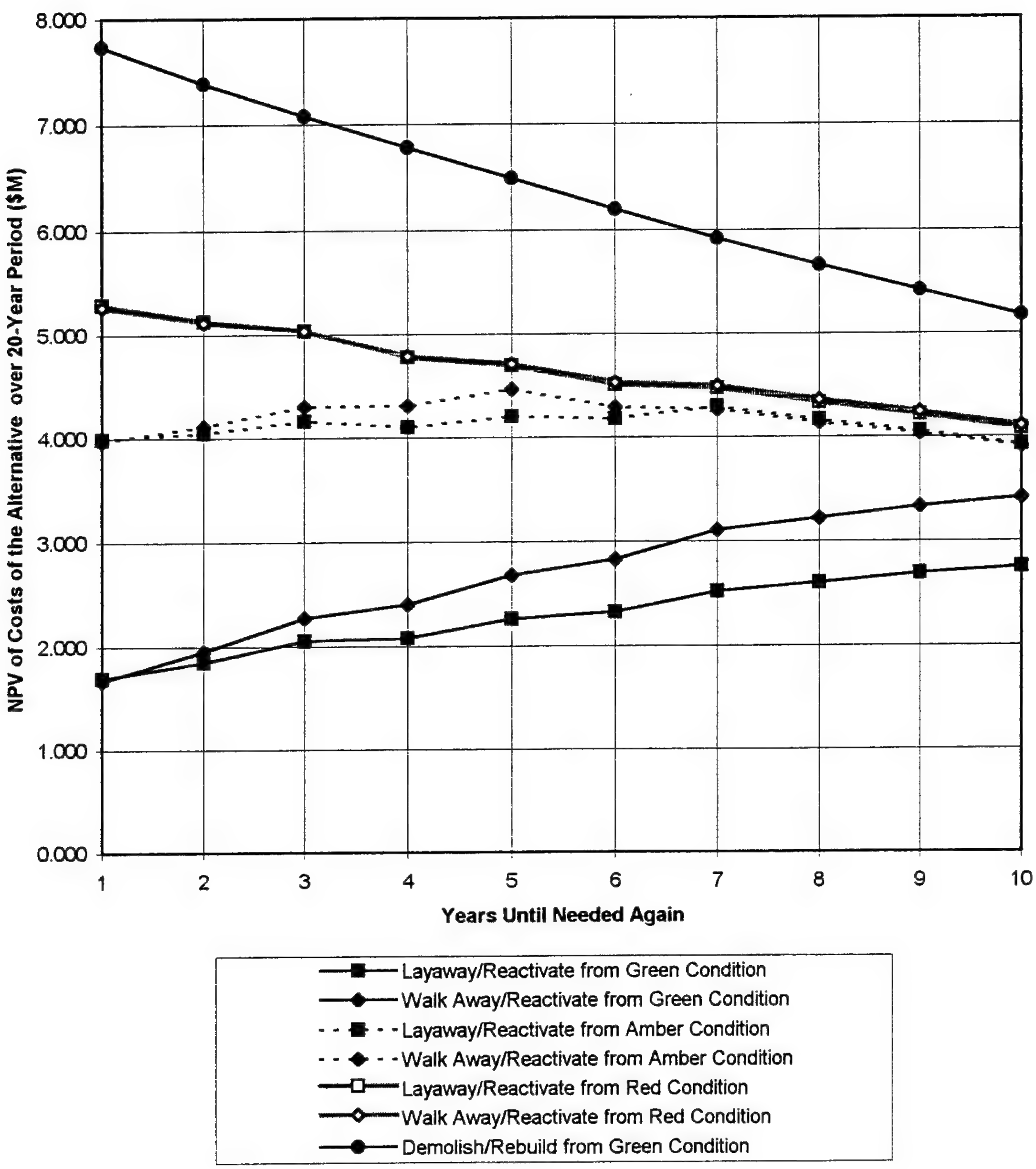
Appendix E: 22600—Ammunition Production Facilities

Comparison of 20-Year Costs by Initial Condition

100% Probability Facility Will Be Needed And Adequate

22600 - Ammunition Production Facilities

(25 years old, 40000 SF, Concrete walls)

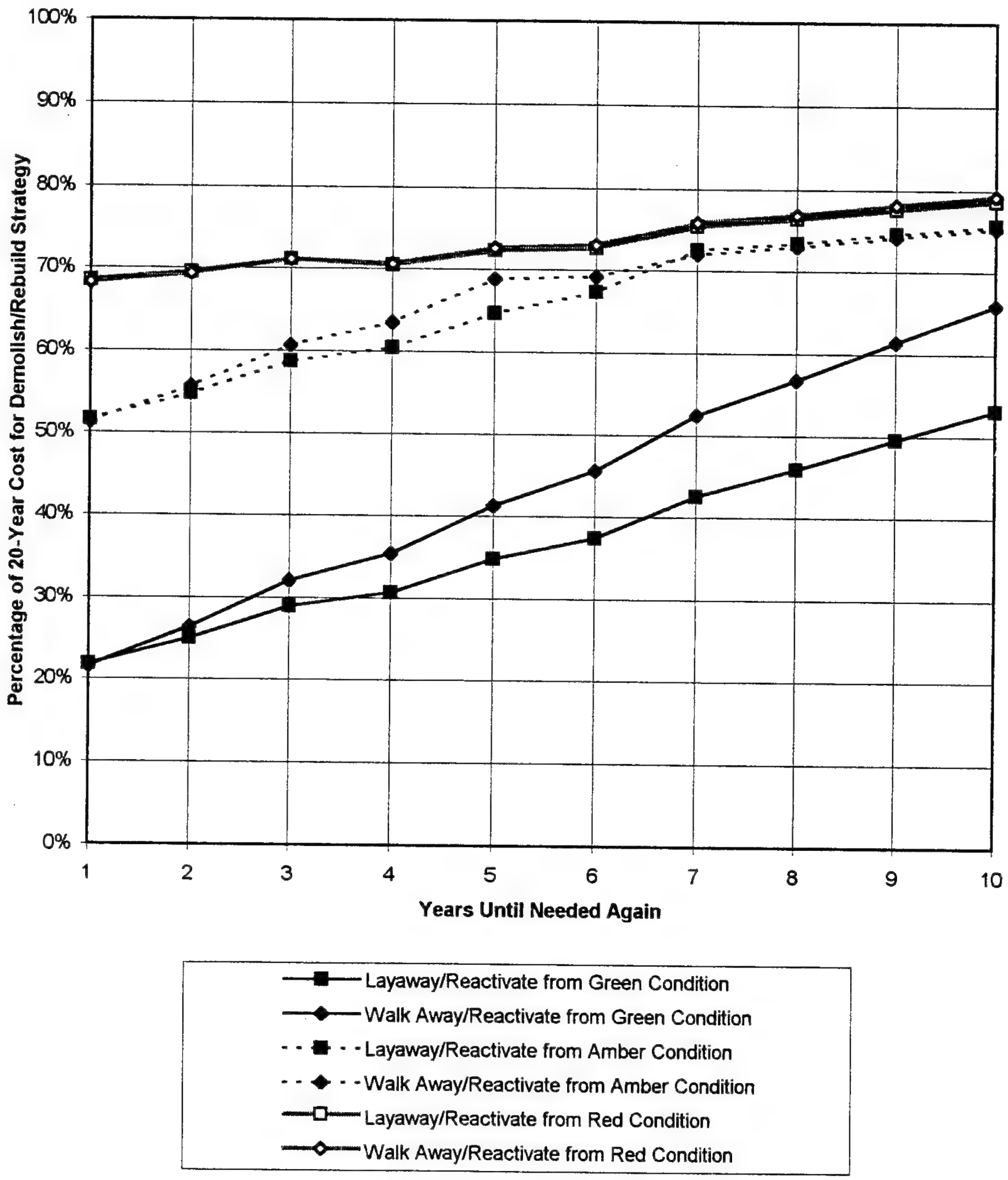


Layaway/Walk Away as Percentage of Demolish/Rebuild

100% Probability Facility Will Be Needed And Adequate

22600 - Ammunition Production Facilities

(25 years old, 40000 SF, Concrete walls)

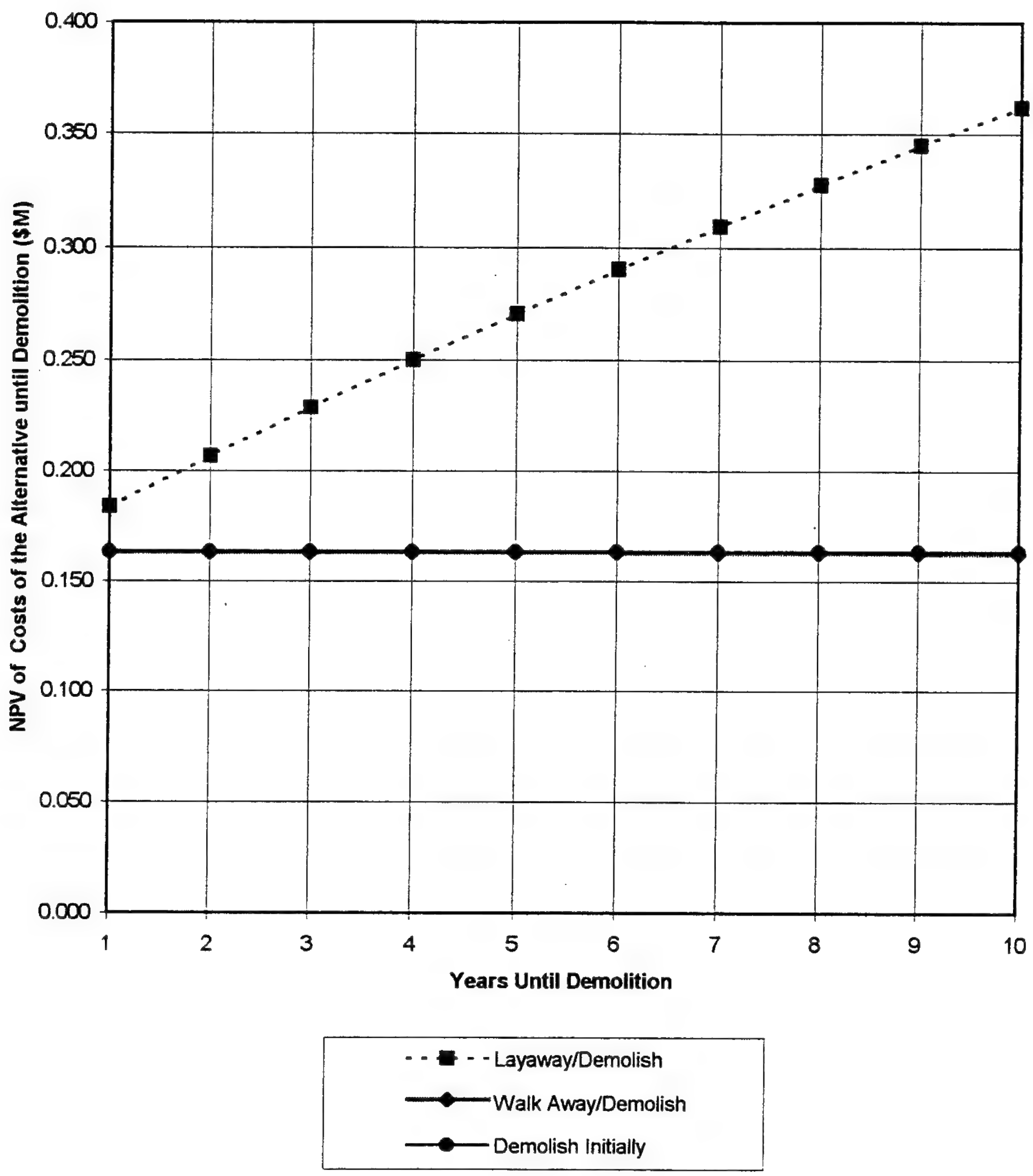


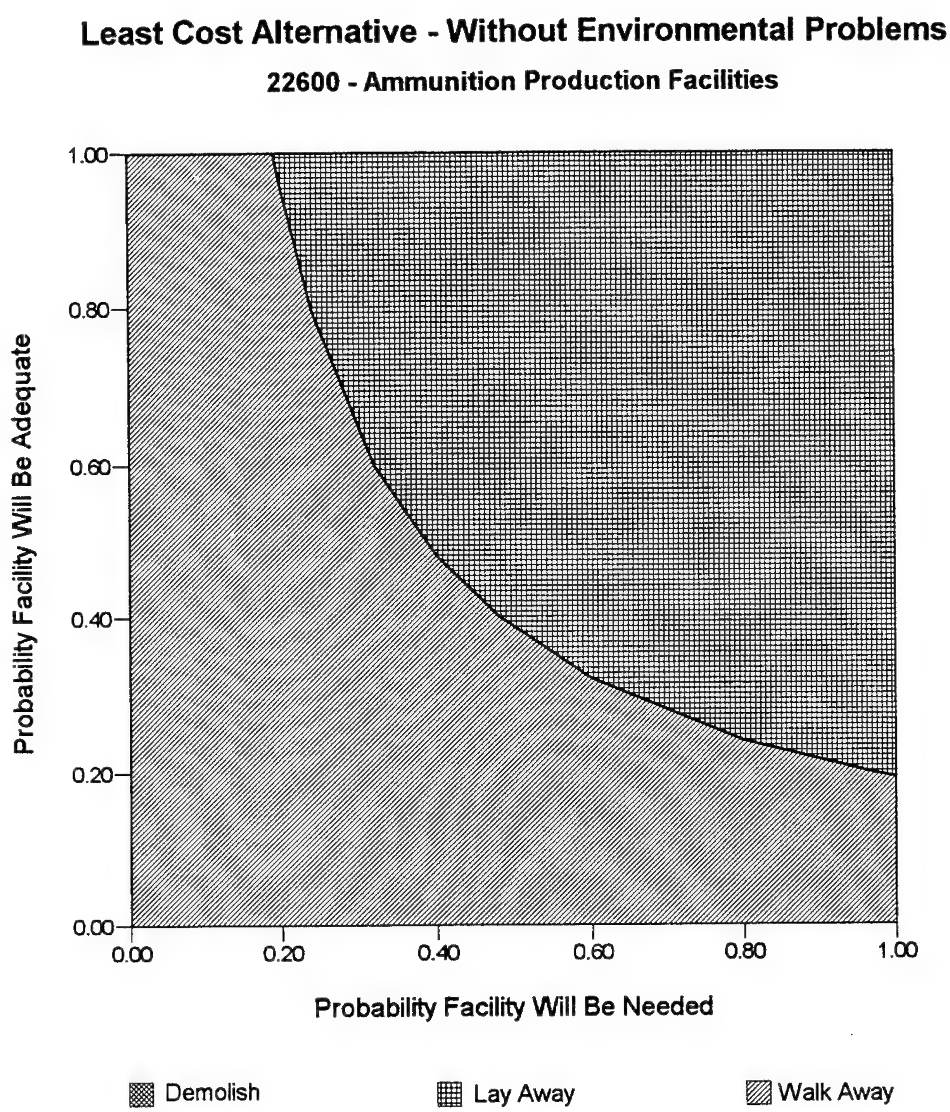
Comparison of Costs If Facility is Never Reactivated

0% Probability Facility Will Be Needed

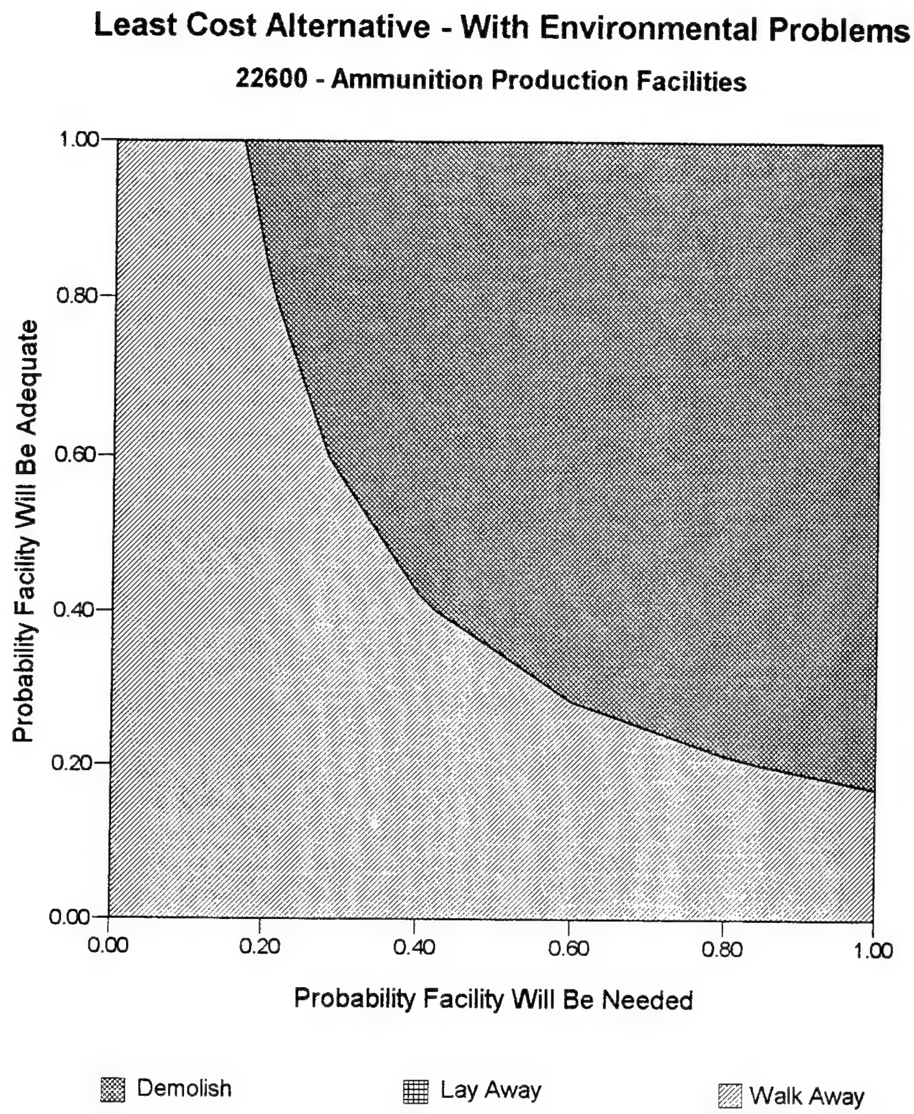
22600 - Ammunition Production Facilities

(25 years old, 40000 SF, Concrete walls)





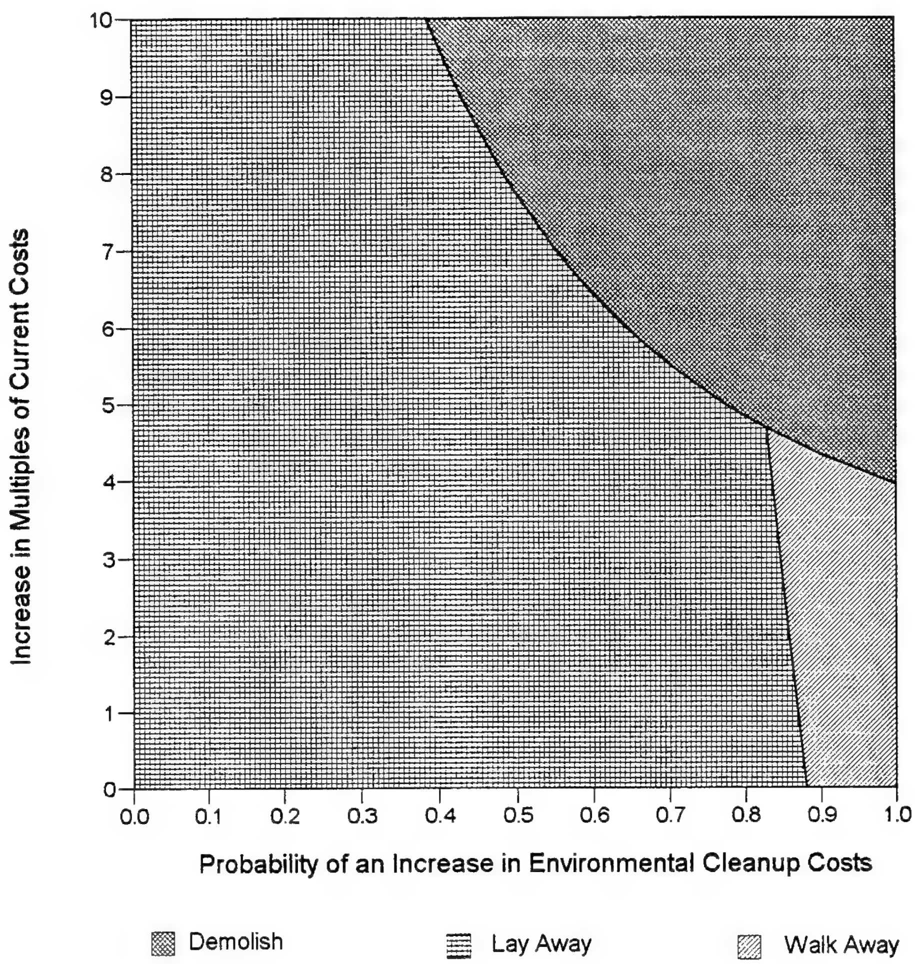
Least Cost Alternative - Without Environmental Problems
22600 - Ammunition Production Facilities
1.00
0.80
0.60
0.40
0.20
0.00
Probability Facility Will Be Adequate
0.00
0.20
0.40
0.60
0.80
1.00
Probability Facility Will Be Needed
Demolish
Lay Away
Walk Away



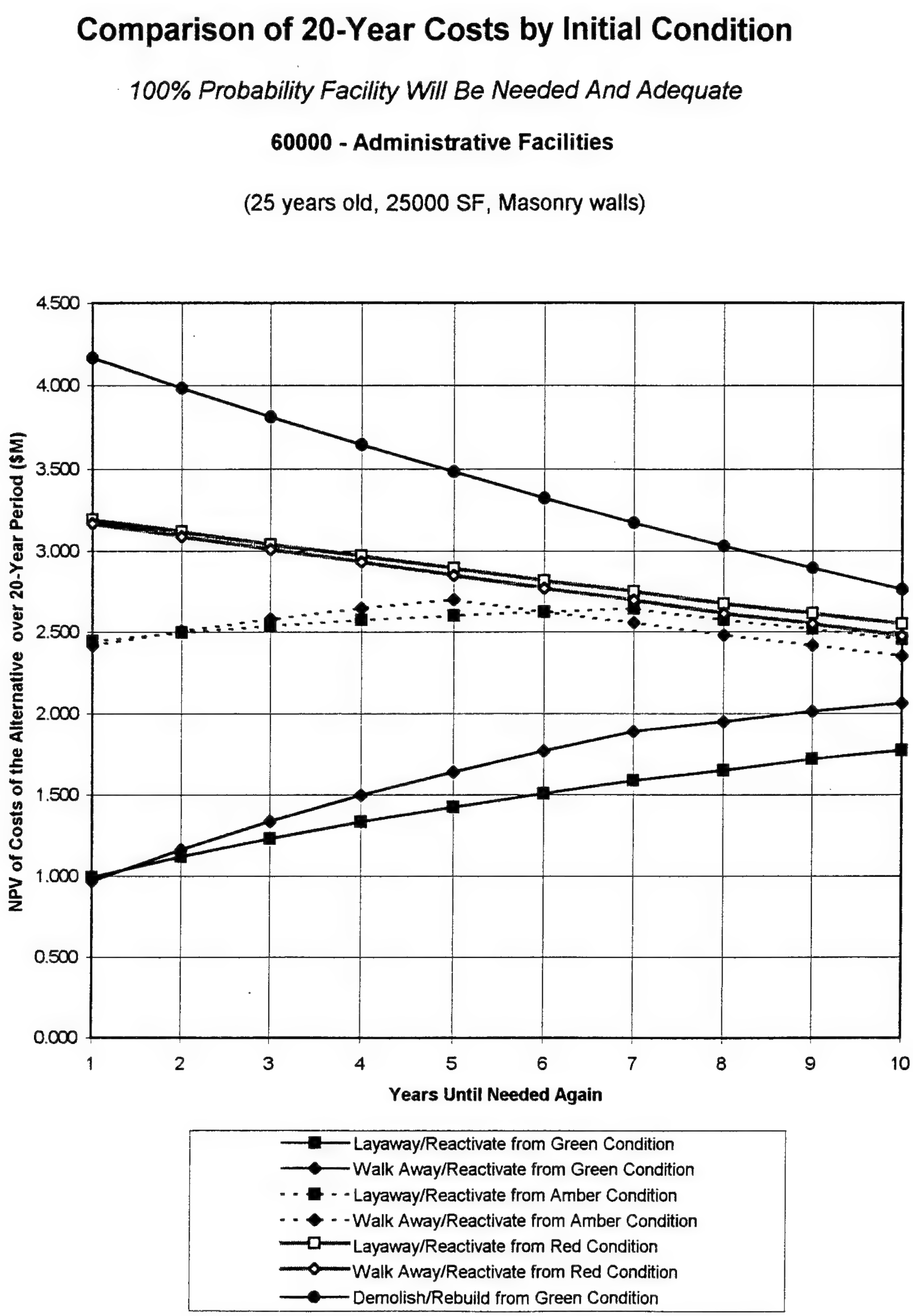
Least Cost Alternative - With Environmental Problems
22600 - Ammunition Production Facilities
Probability Facility Will Be Adequate
1.00
0.80
0.60
0.40
0.20
0.00
0.00
0.20
0.40
0.60
0.80
1.00
Probability Facility Will Be Needed
Demolish
Lay Away
Walk Away

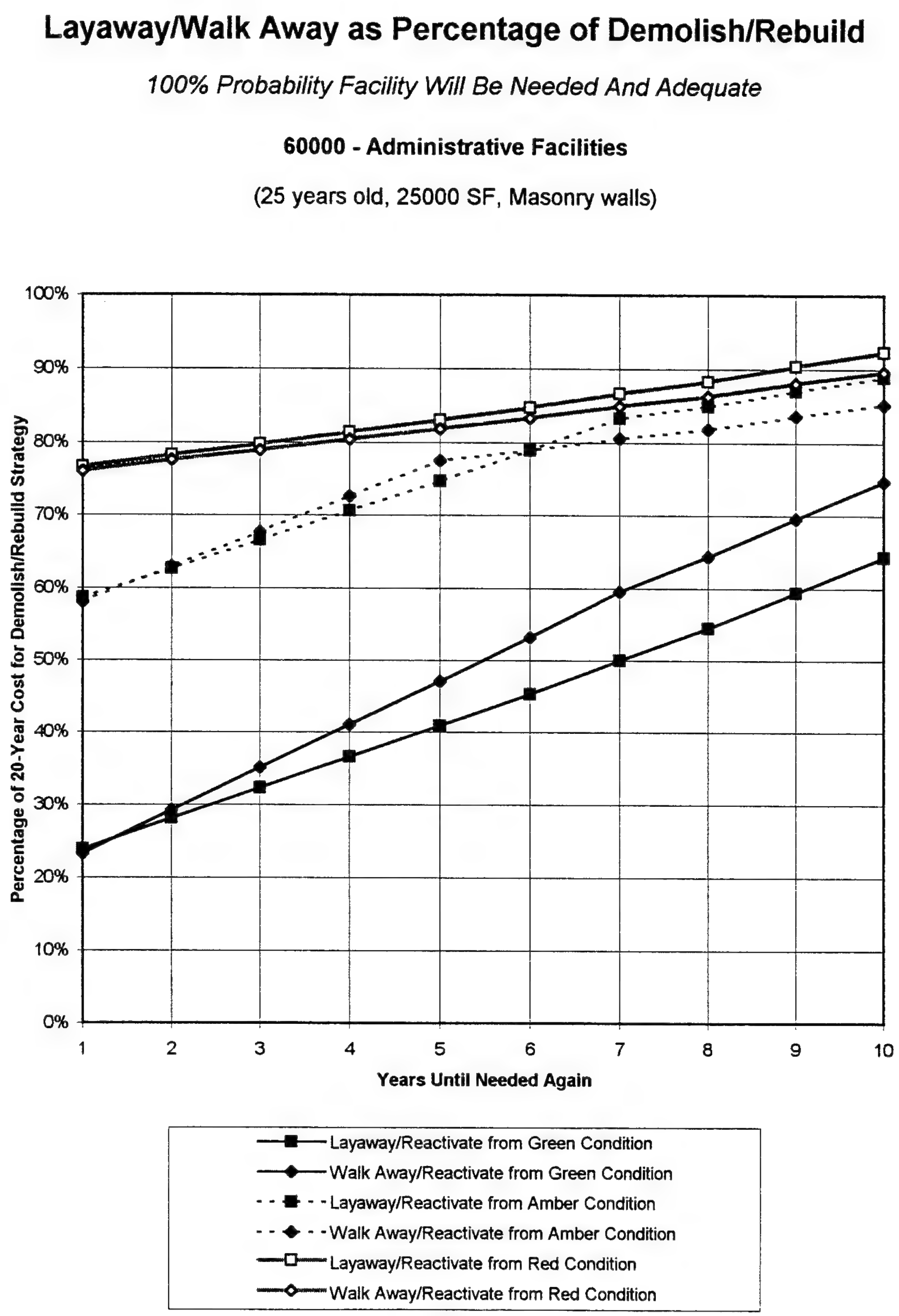
Least Cost Alternative - Environmental Problems Increase

22600 - Ammunition Production Facilities



Appendix F: 60000—Administrative Facilities


Comparison of 20-Year Costs by Initial Condition
100% Probability Facility Will Be Needed And Adequate
60000 - Administrative Facilities
(25 years old, 25000 SF, Masonry walls)
4.500
4.000
3.500
3.000
2.500
2.000
1.500
1.000
0.500
0.000
NPV of Costs of the Alternative over 20-Year Period ($M)
1
2
3
4
5
6
7
8
9
10
Years Until Needed Again
Layaway/Reactivate from Green Condition
Walk Away/Reactivate from Green Condition
Layaway/Reactivate from Amber Condition
Walk Away/Reactivate from Amber Condition
Layaway/Reactivate from Red Condition
Walk Away/Reactivate from Red Condition
Demolish/Rebuild from Green Condition

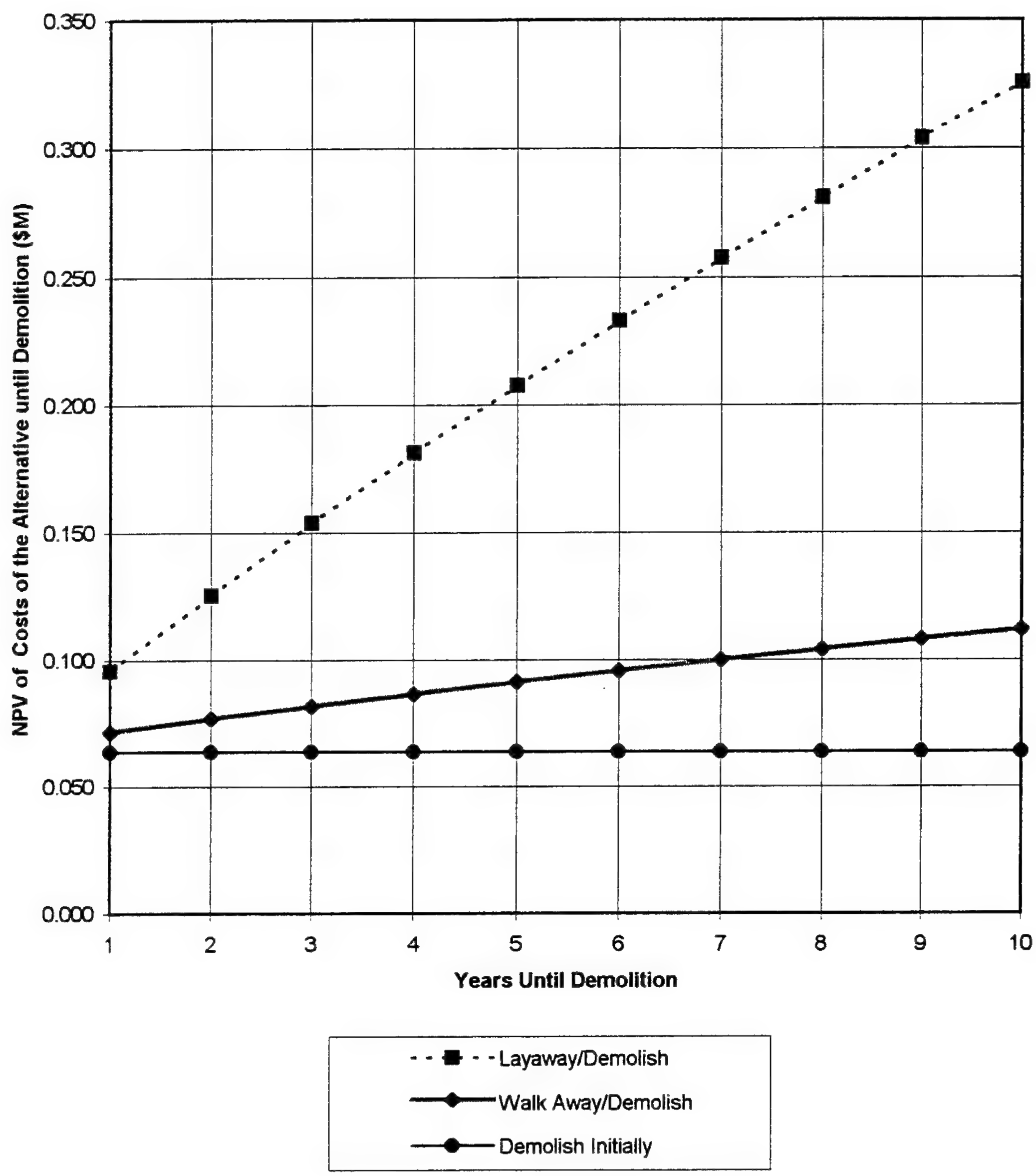

Layaway/Walk Away as Percentage of Demolish/Rebuild
100% Probability Facility Will Be Needed And Adequate
60000 - Administrative Facilities
(25 years old, 25000 SF, Masonry walls)
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Percentage of 20-Year Cost for Demolish/Rebuild Strategy
1
2
3
4
5
6
7
8
9
10
Years Until Needed Again
Layaway/Reactivate from Green Condition
Walk Away/Reactivate from Green Condition
Layaway/Reactivate from Amber Condition
Walk Away/Reactivate from Amber Condition
Layaway/Reactivate from Red Condition
Walk Away/Reactivate from Red Condition

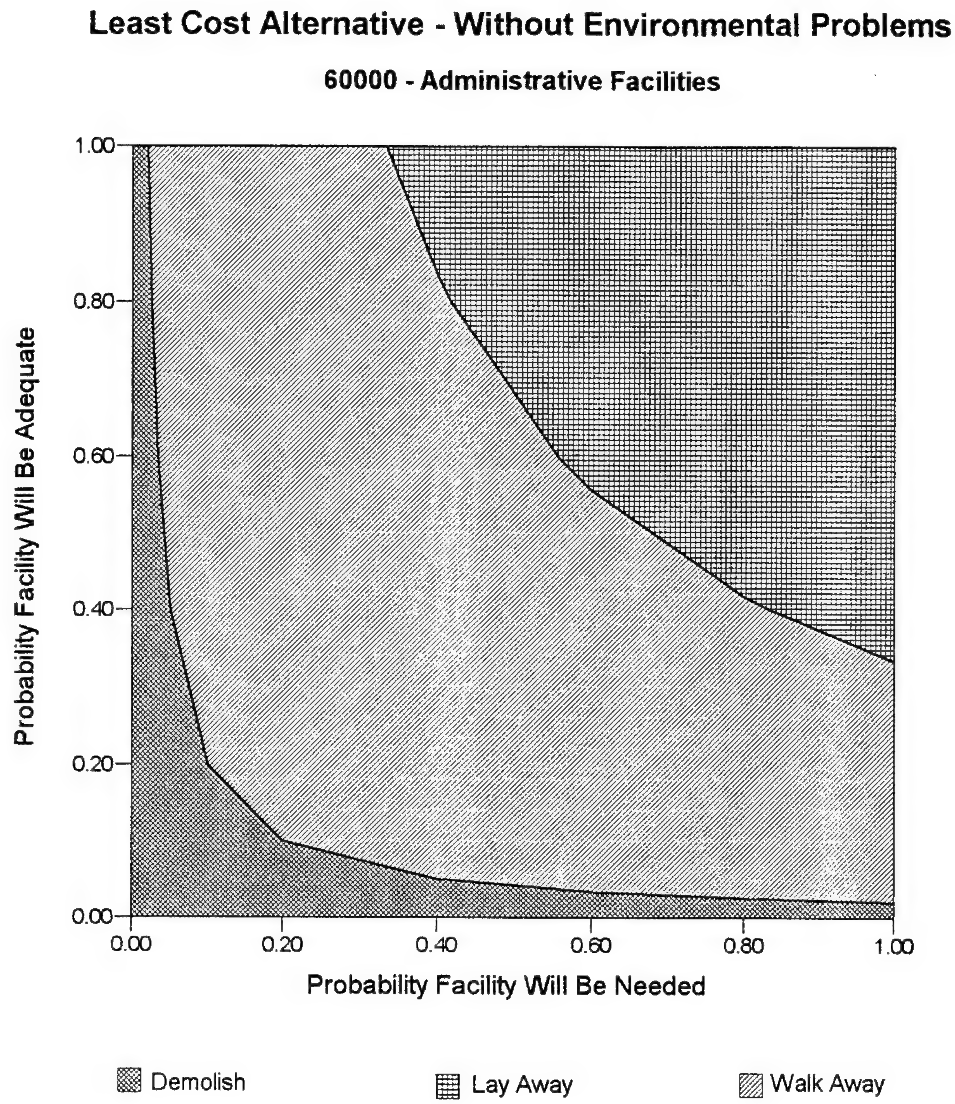
Comparison of Costs If Facility is Never Reactivated

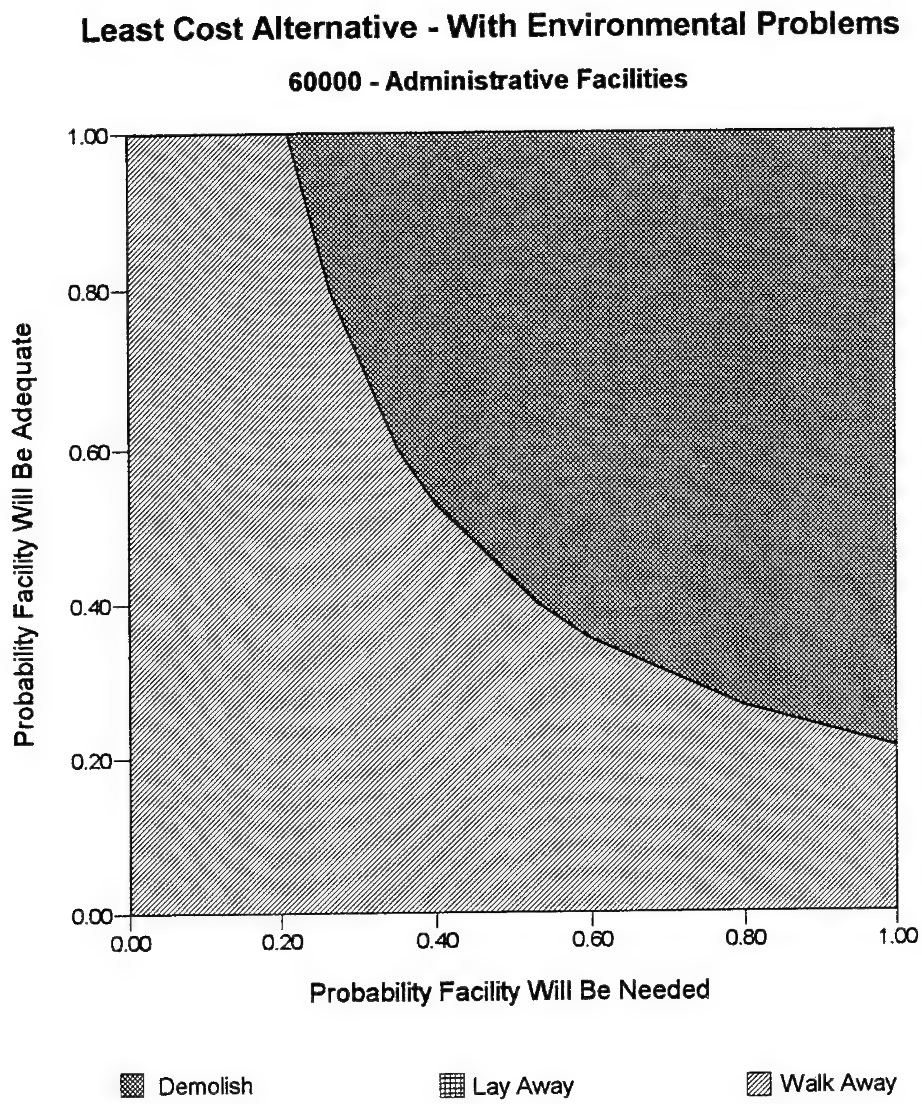
0% Probability Facility Will Be Needed

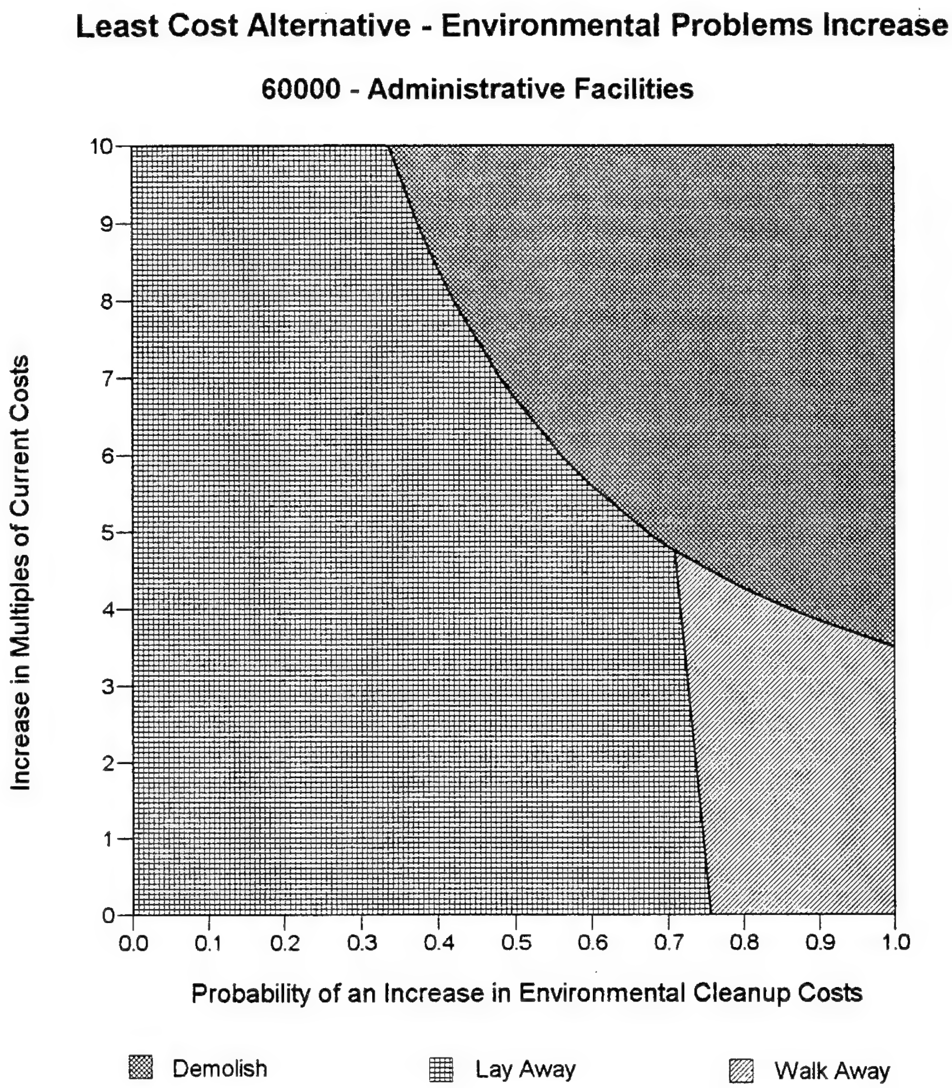
60000 - Administrative Facilities

(25 years old, 25000 SF, Masonry walls)

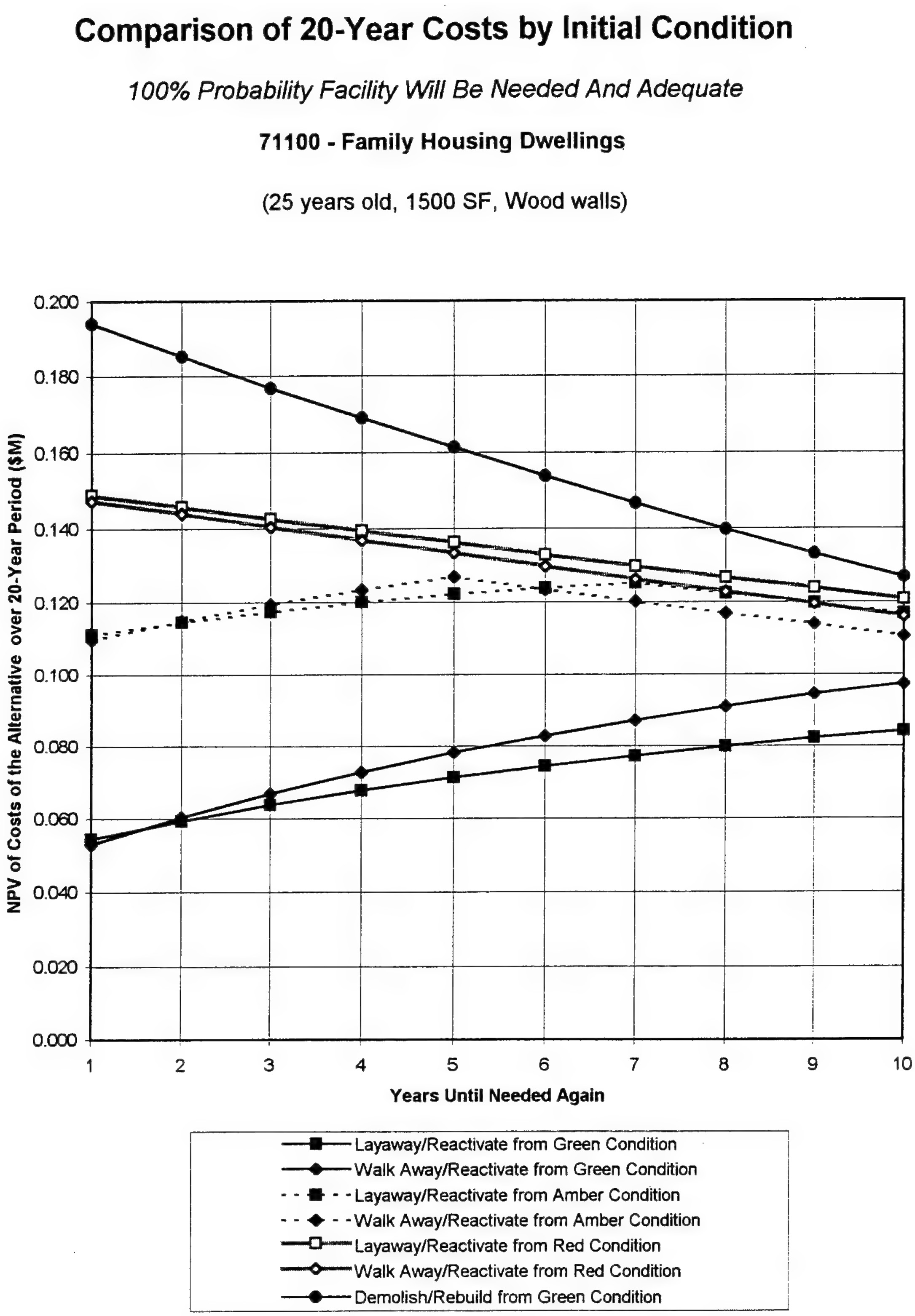


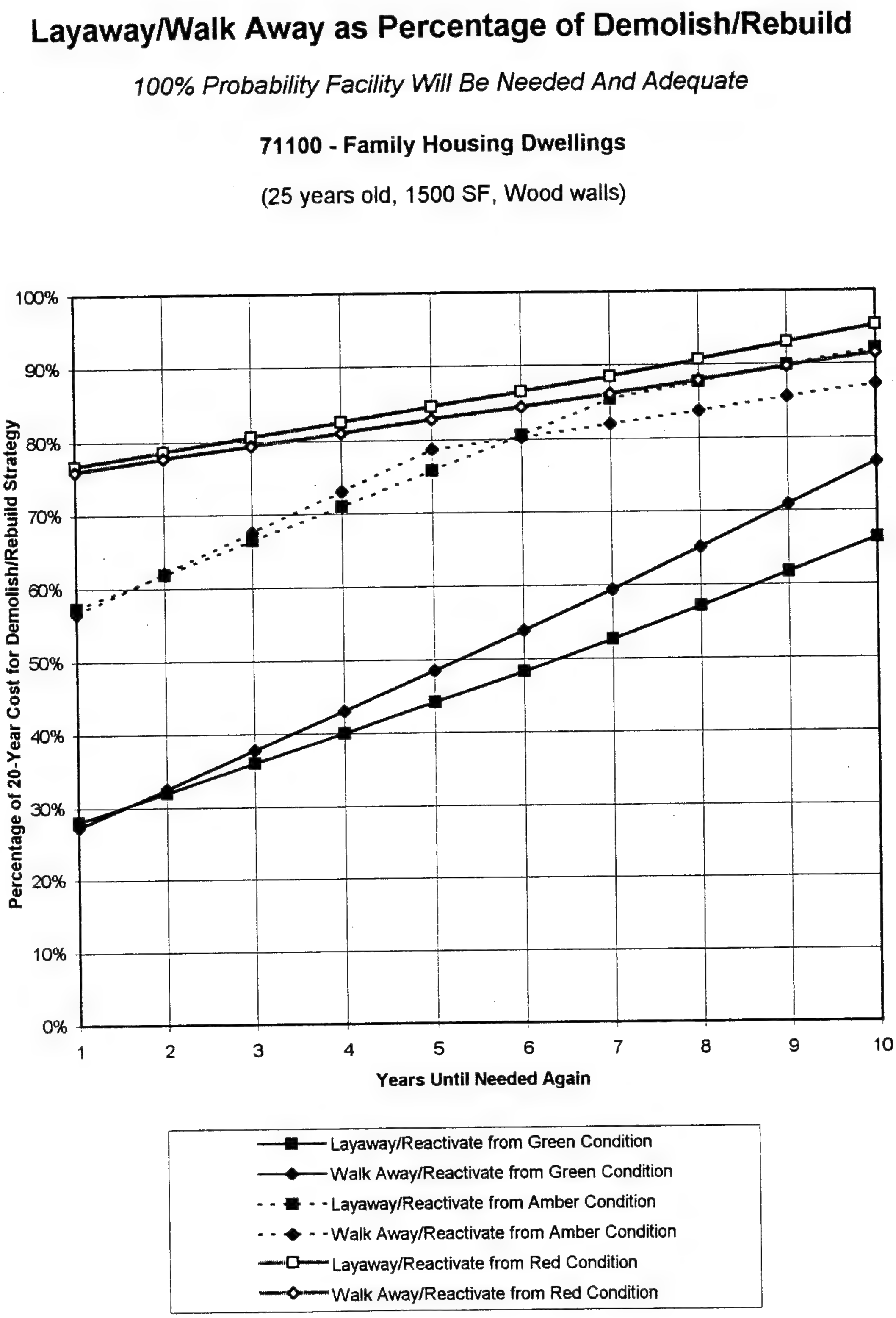

Least Cost Alternative - Without Environmental Problems
60000 - Administrative Facilities
Probability Facility Will Be Adequate
1.00
0.80
0.60
0.40
0.20
0.00
0.00
0.20
0.40
0.60
0.80
1.00
Probability Facility Will Be Needed
Demolish
Lay Away
Walk Away

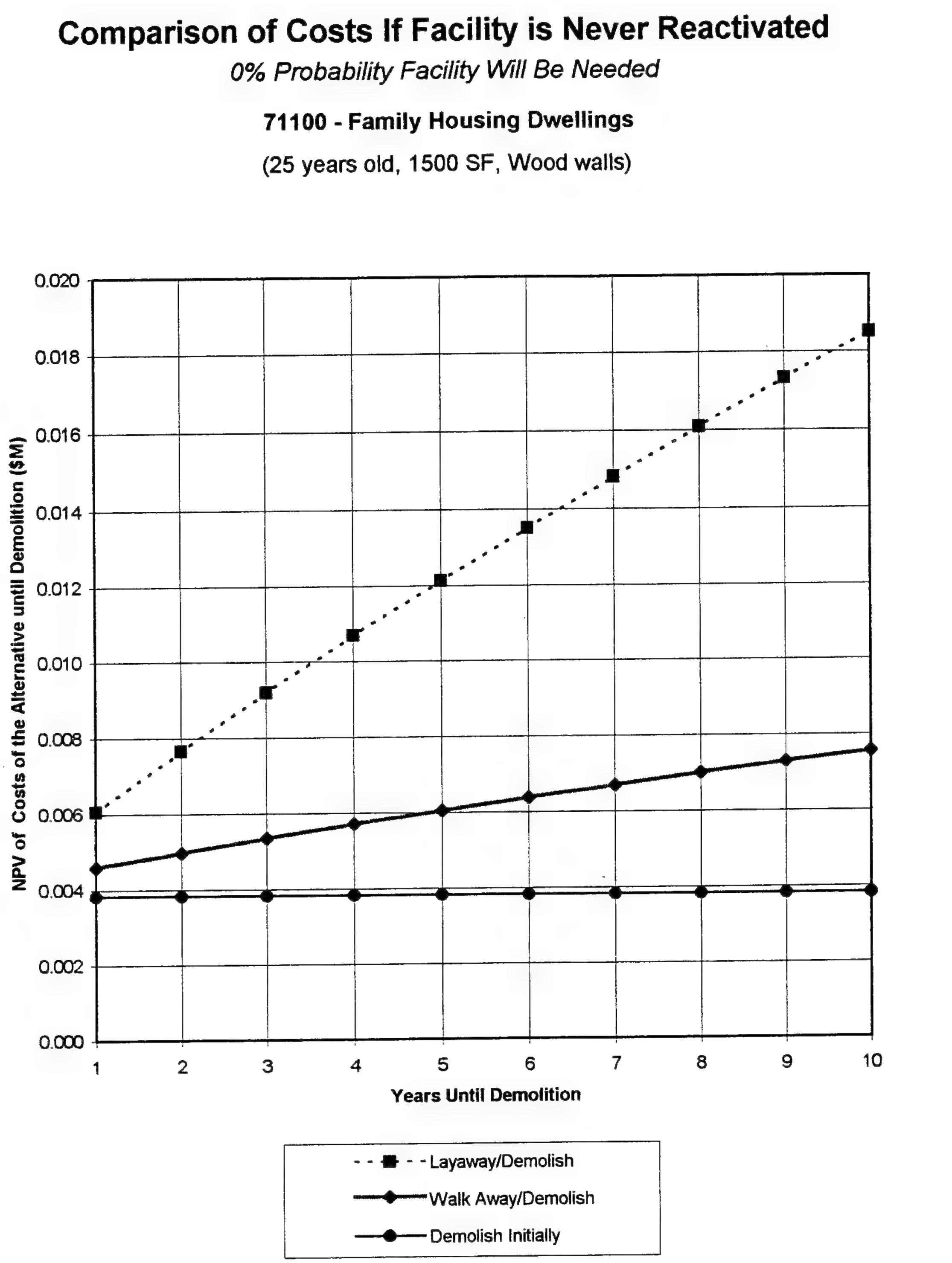

Least Cost Alternative - With Environmental Problems
60000 - Administrative Facilities
Probability Facility Will Be Adequate
1.00
0.80
0.60
0.40
0.20
0.00
0.00
0.20
0.40
0.60
0.80
1.00
Probability Facility Will Be Needed
Demolish
Lay Away
Walk Away

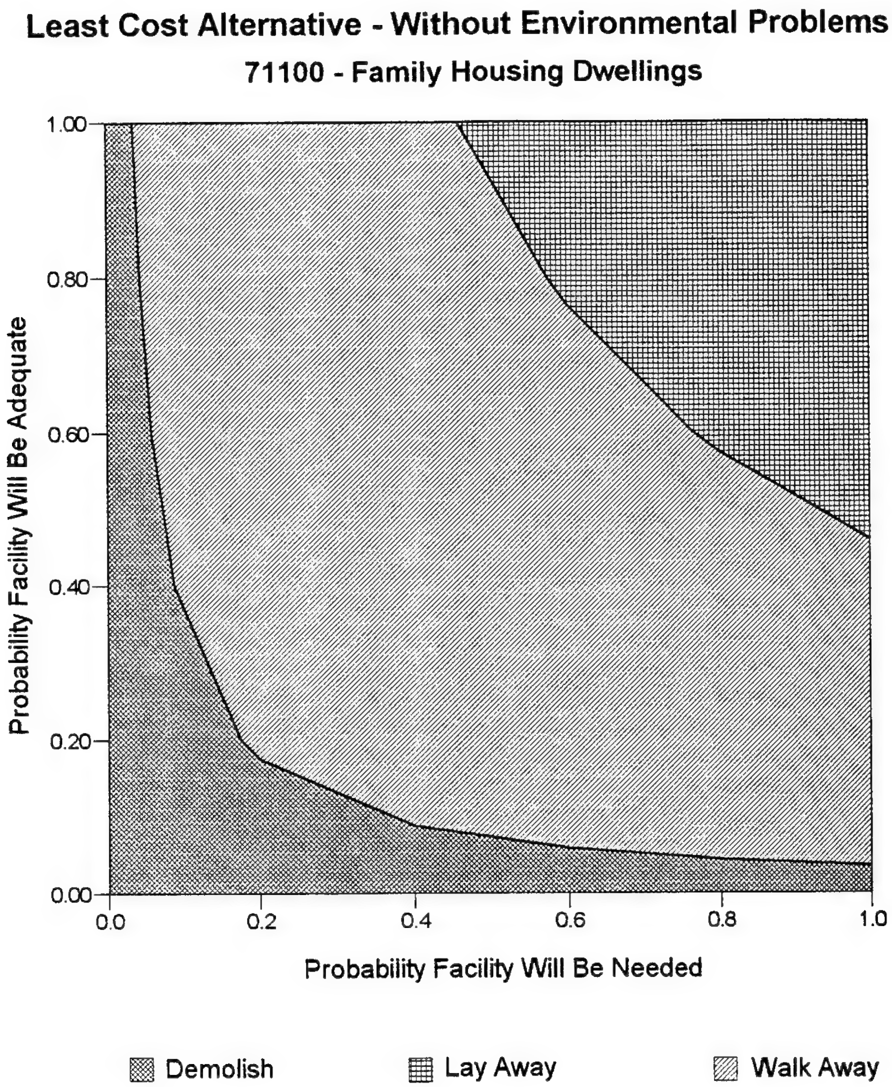

Least Cost Alternative - Environmental Problems Increase
60000 - Administrative Facilities
Increase in Multiples of Current Costs
0
1
2
3
4
5
6
7
8
9
10
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
Probability of an Increase in Environmental Cleanup Costs
Demolish
Lay Away
Walk Away

Appendix G: 71100—Family Housing Dwellings

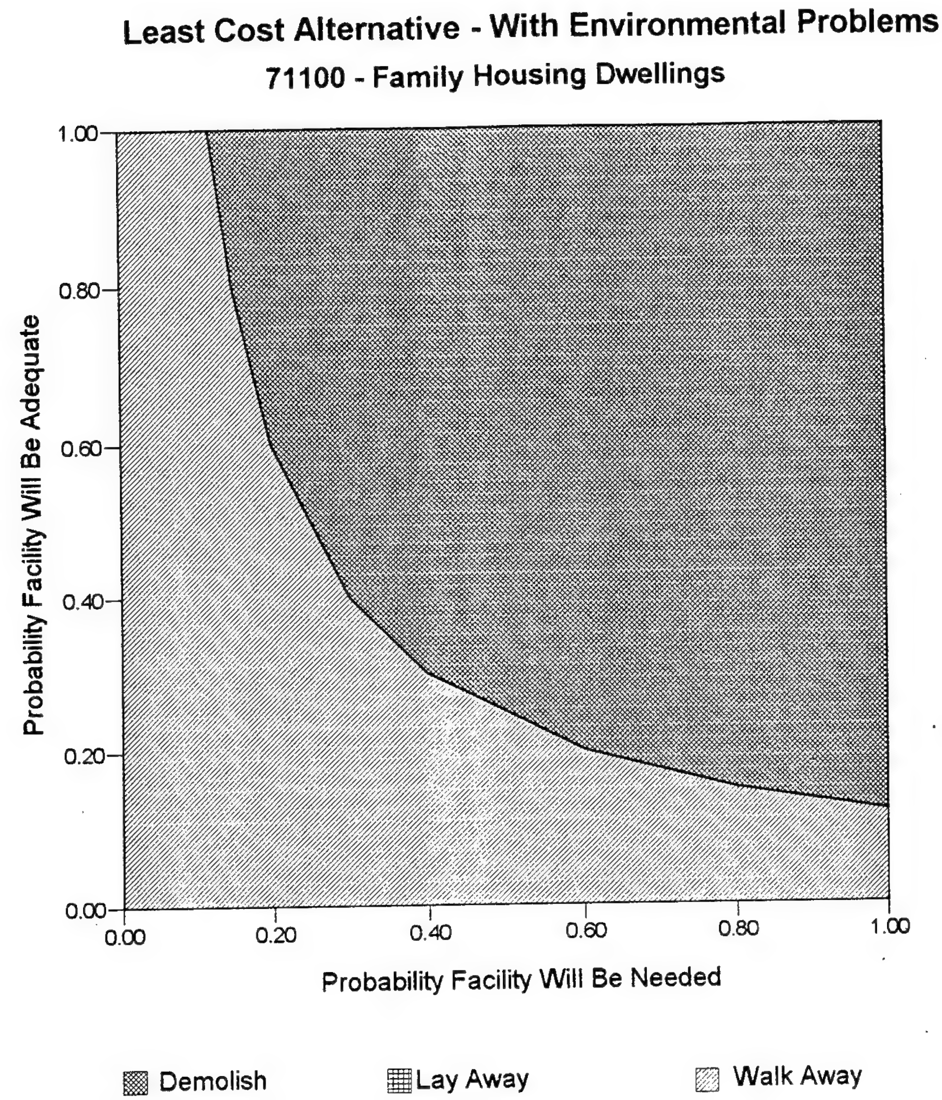

Comparison of 20-Year Costs by Initial Condition
100% Probability Facility Will Be Needed And Adequate
71100 - Family Housing Dwellings
(25 years old, 1500 SF, Wood walls)
NPV of Costs of the Alternative over 20-Year Period ($M)
0.200
0.180
0.160
0.140
0.120
0.100
0.080
0.060
0.040
0.020
0.000
1
2
3
4
5
6
7
8
9
10
Years Until Needed Again
Layaway/Reactivate from Green Condition
Walk Away/Reactivate from Green Condition
Layaway/Reactivate from Amber Condition
Walk Away/Reactivate from Amber Condition
Layaway/Reactivate from Red Condition
Walk Away/Reactivate from Red Condition
Demolish/Rebuild from Green Condition

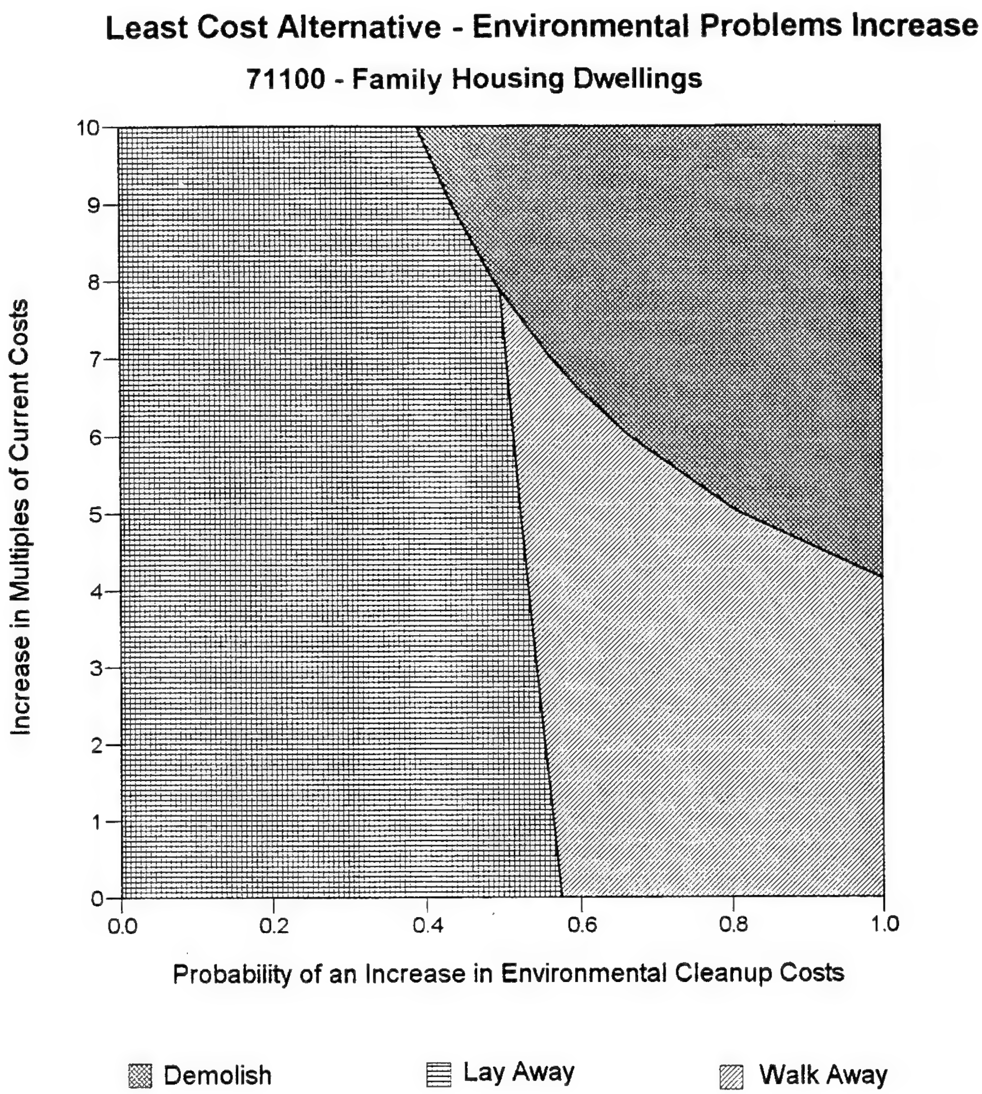

Layaway/Walk Away as Percentage of Demolish/Rebuild
100% Probability Facility Will Be Needed And Adequate
71100 - Family Housing Dwellings
(25 years old, 1500 SF, Wood walls)
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Percentage of 20-Year Cost for Demolish/Rebuild Strategy
1
2
3
4
5
6
7
8
9
10
Years Until Needed Again
Layaway/Reactivate from Green Condition
Walk Away/Reactivate from Green Condition
Layaway/Reactivate from Amber Condition
Walk Away/Reactivate from Amber Condition
Layaway/Reactivate from Red Condition
Walk Away/Reactivate from Red Condition


Comparison of Costs If Facility is Never Reactivated
0% Probability Facility Will Be Needed
71100 - Family Housing Dwellings
(25 years old, 1500 SF, Wood walls)
NPV of Costs of the Alternative until Demolition ($M)
0.020
0.018
0.016
0.014
0.012
0.010
0.008
0.006
0.004
0.002
0.000
1
2
3
4
5
6
7
8
9
10
Years Until Demolition
Layaway/Demolish
Walk Away/Demolish
Demolish Initially



Least Cost Alternative - Without Environmental Problems
71100 - Family Housing Dwellings
Probability Facility Will Be Adequate
1.00
0.80
0.60
0.40
0.20
0.00
0.0
0.2
0.4
0.6
0.8
1.0
Probability Facility Will Be Needed
Demolish
Lay Away
Walk Away


Least Cost Alternative - With Environmental Problems
71100 - Family Housing Dwellings
1.00
0.80
0.60
0.40
0.20
0.00
Probability Facility Will Be Adequate
0.00
0.20
0.40
0.60
0.80
1.00
Probability Facility Will Be Needed
Demolish
Lay Away
Walk Away


Least Cost Alternative - Environmental Problems Increase
71100 - Family Housing Dwellings
Increase in Multiples of Current Costs
0
1
2
3
4
5
6
7
8
9
10
0.0
0.2
0.4
0.6
0.8
1.0
Probability of an Increase in Environmental Cleanup Costs
Demolish
Lay Away
Walk Away

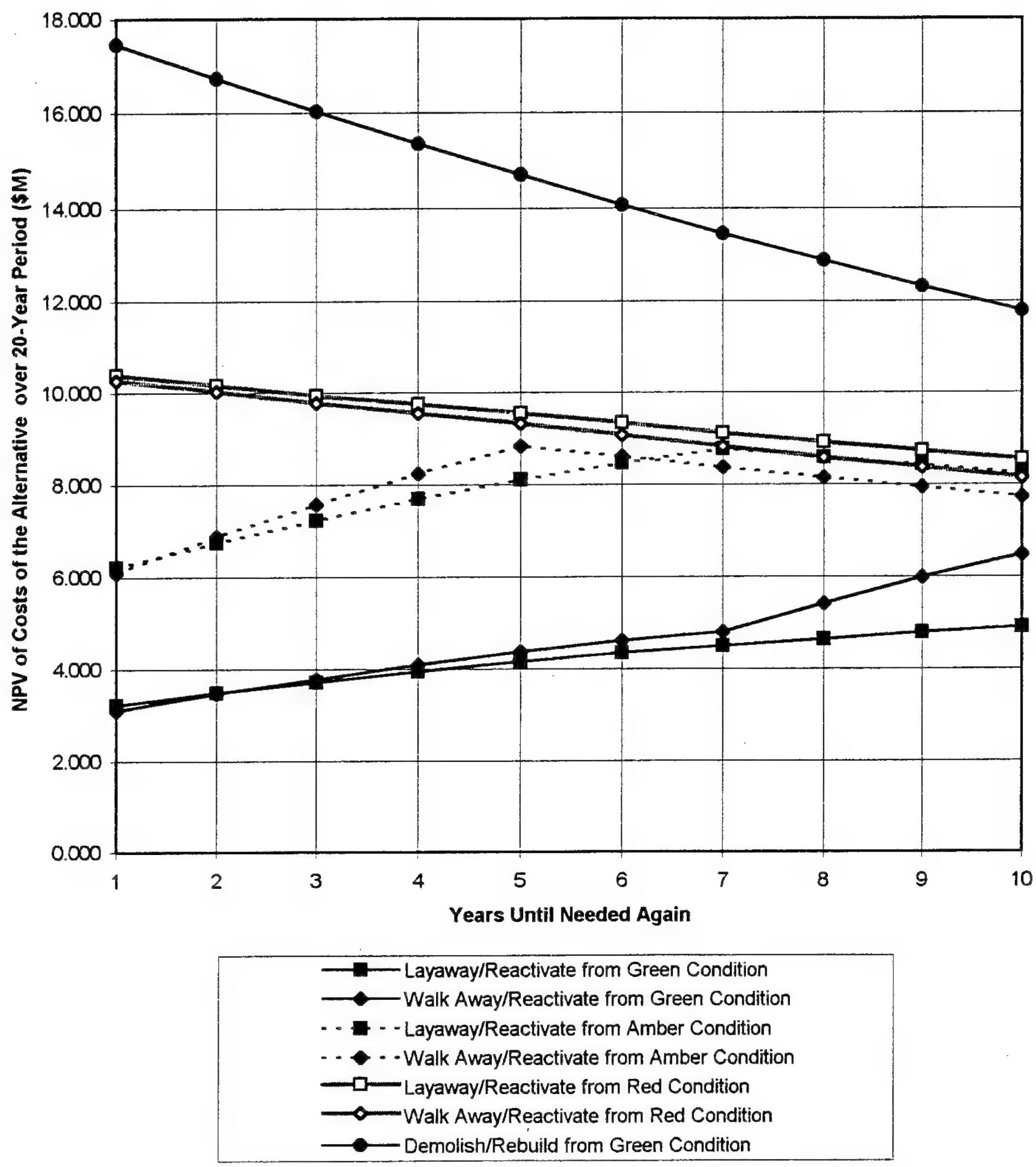
Appendix H: 72100—Unaccompanied Personnel Housing

Comparison of 20-Year Costs by Initial Condition

100% Probability Facility Will Be Needed And Adequate

72100 - Unaccompanied Personnel Housing

(25 years old, 99500 SF, Masonry walls)

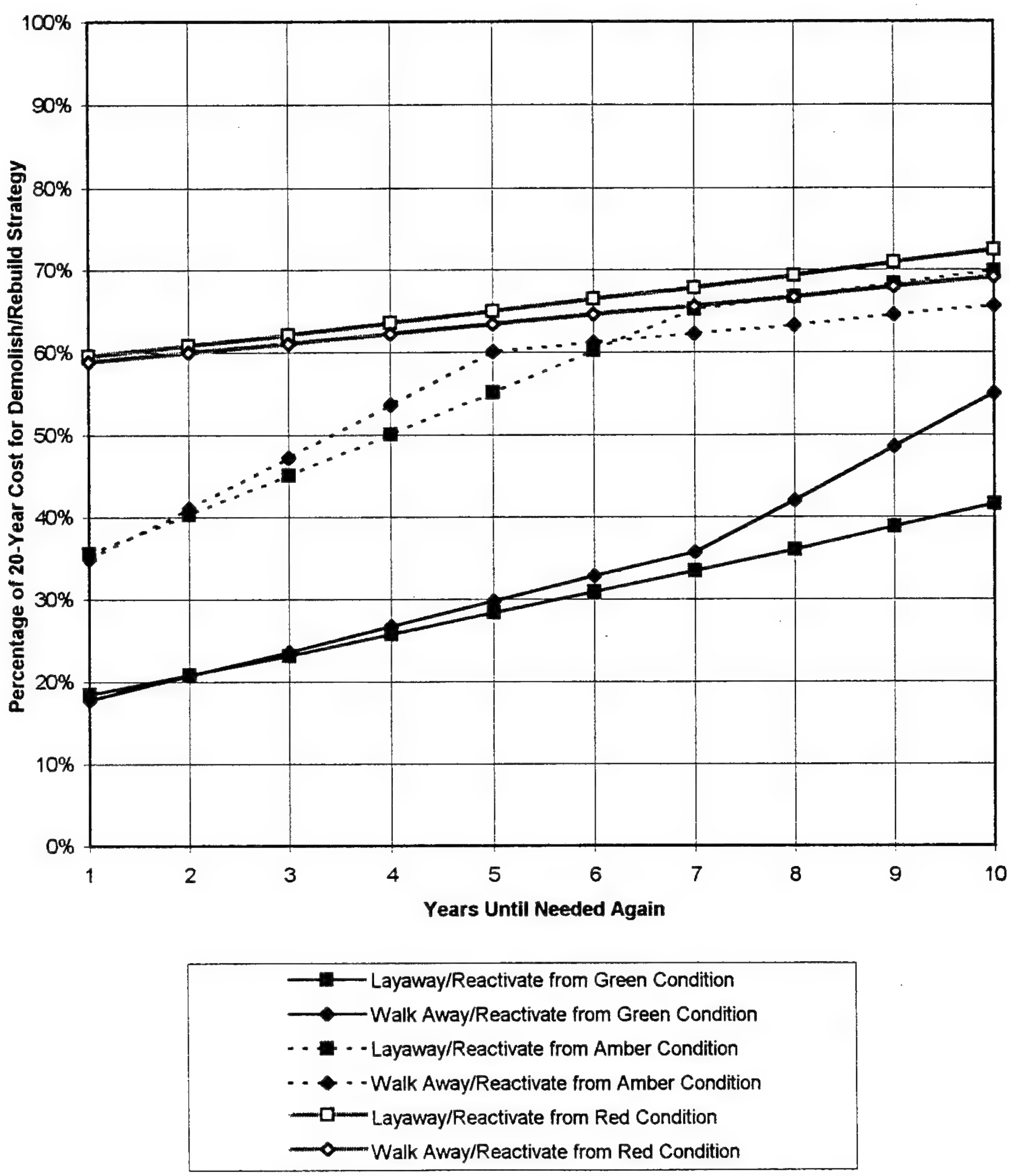


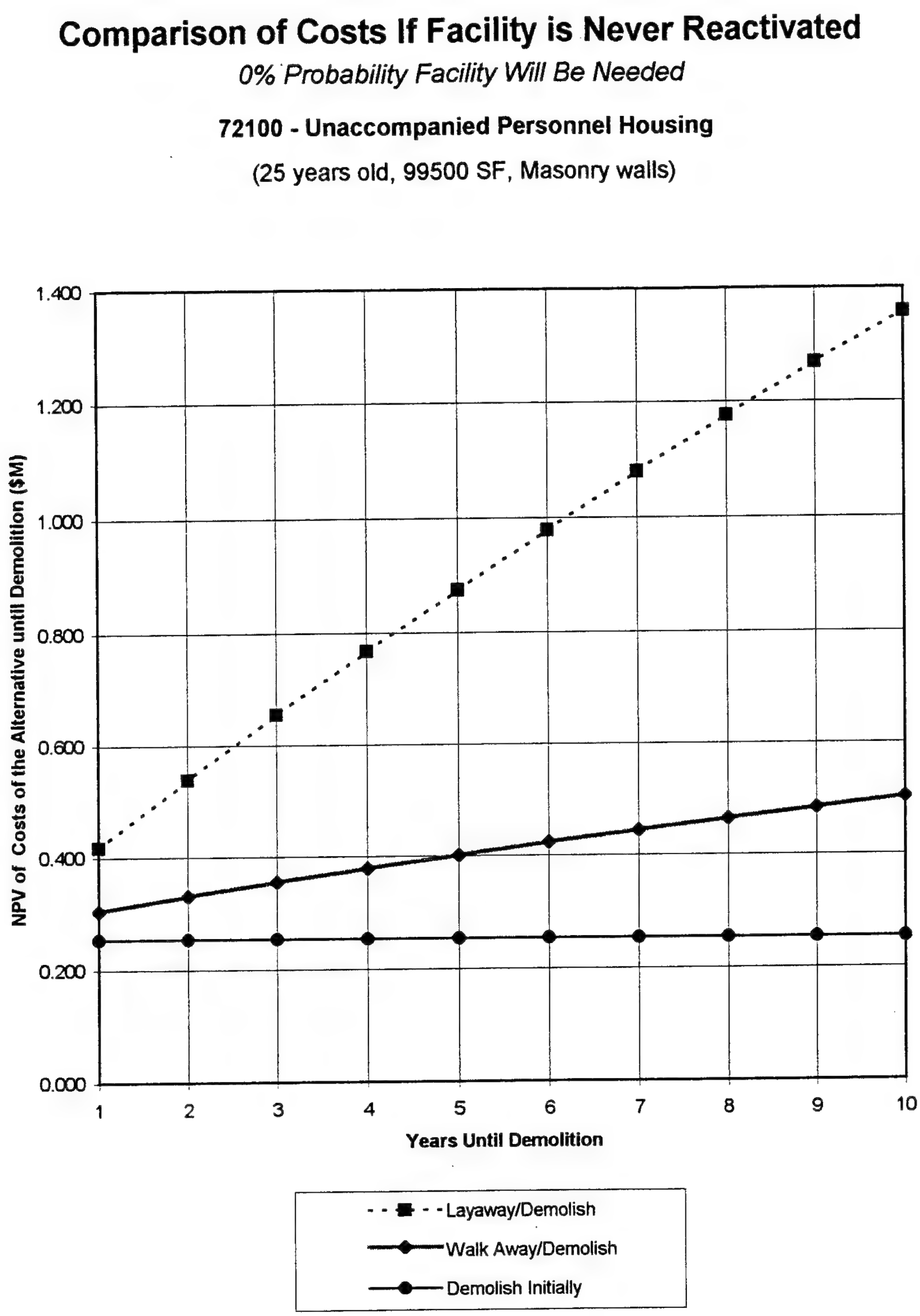
Layaway/Walk Away as Percentage of Demolish/Rebuild

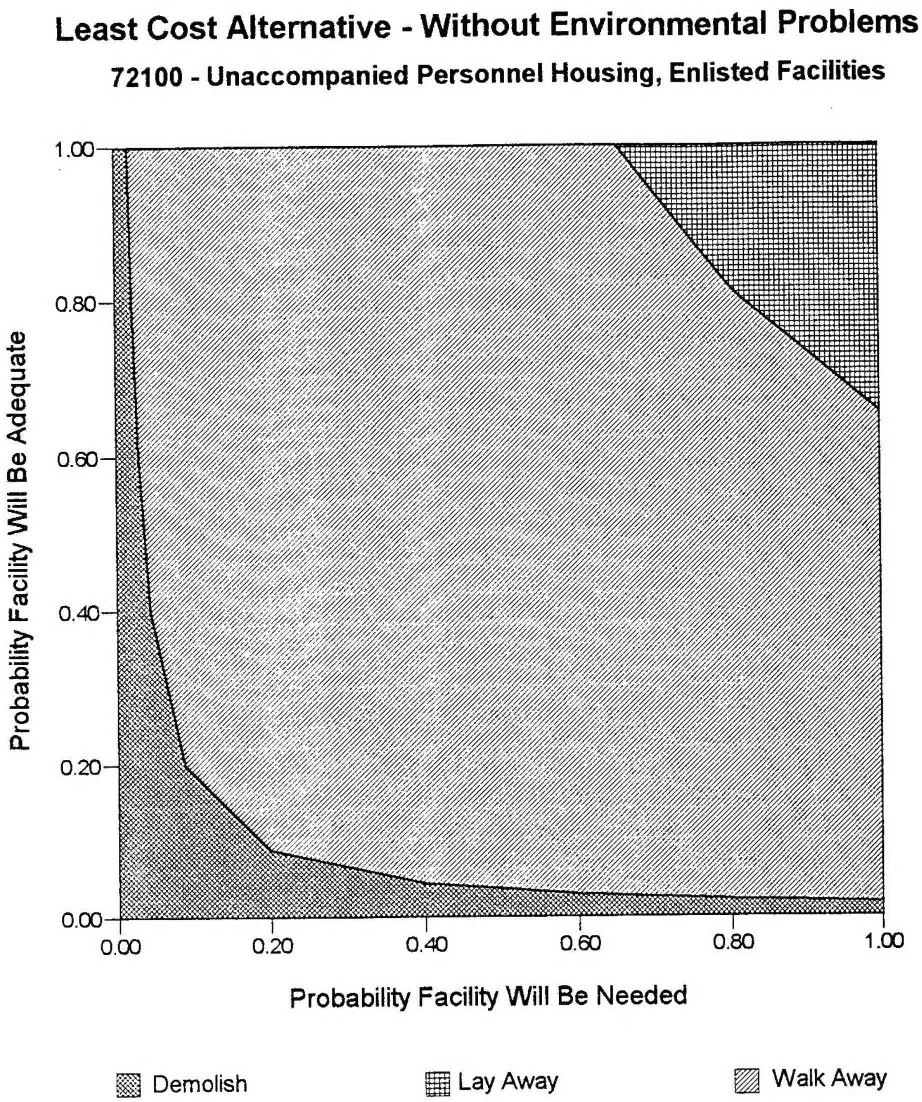
100% Probability Facility Will Be Needed And Adequate

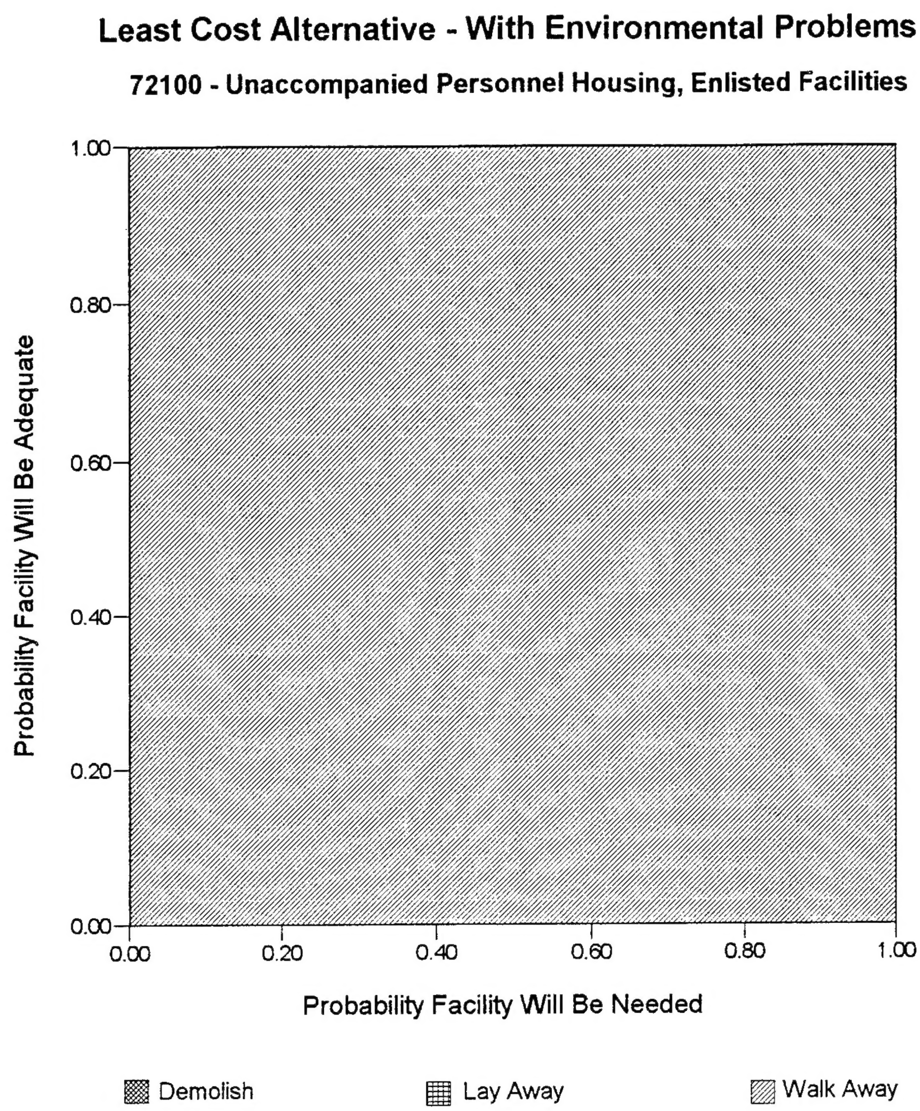
72100 - Unaccompanied Personnel Housing

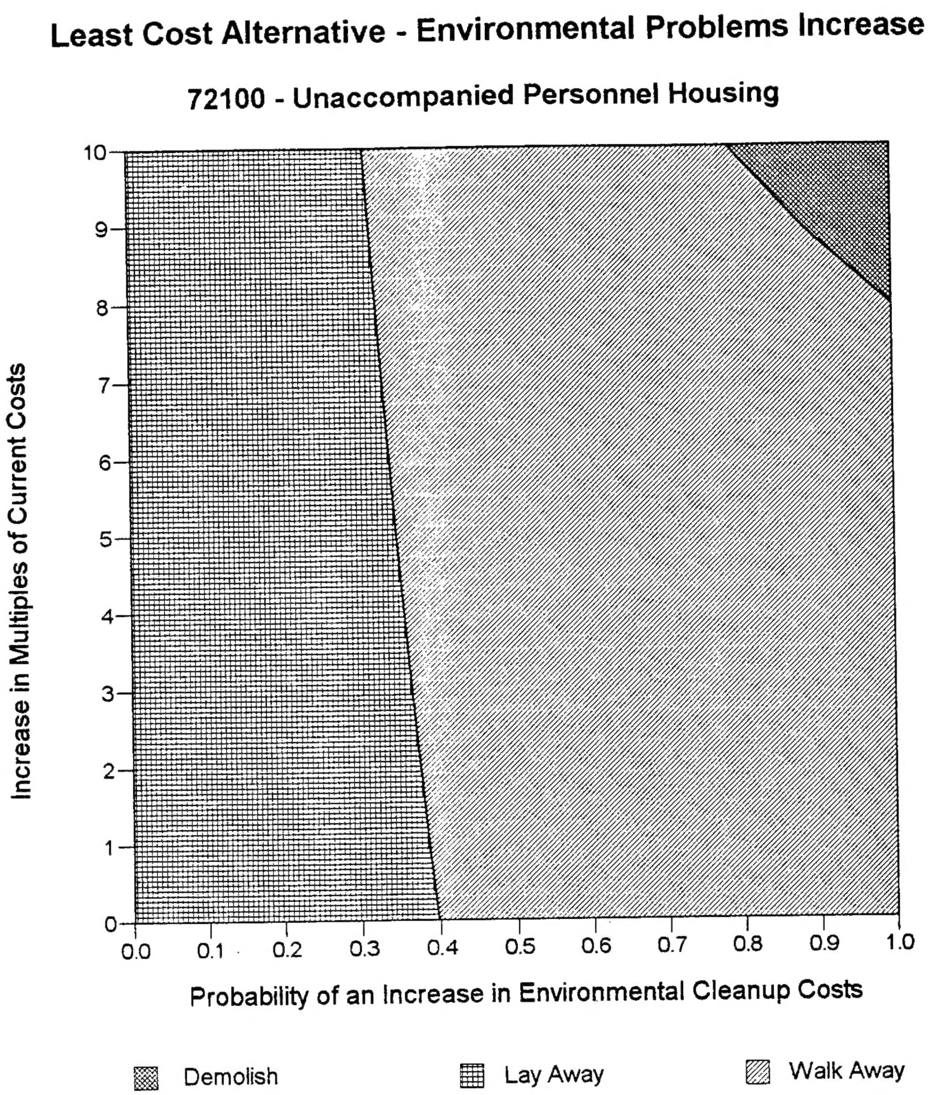
(25 years old, 99500 SF, Masonry walls)




Comparison of Costs If Facility is Never Reactivated
0% Probability Facility Will Be Needed
72100 - Unaccompanied Personnel Housing
(25 years old, 99500 SF, Masonry walls)
1.400
1.200
1.000
0.800
0.600
0.400
0.200
0.000
NPV of Costs of the Alternative until Demolition ($M)
1
2
3
4
5
6
7
8
9
10
Years Until Demolition
Layaway/Demolish
Walk Away/Demolish
Demolish Initially


Least Cost Alternative - Without Environmental Problems
72100 - Unaccompanied Personnel Housing, Enlisted Facilities
1.00
0.80
0.60
0.40
0.20
0.00
Probability Facility Will Be Adequate
0.00
0.20
0.40
0.60
0.80
1.00
Probability Facility Will Be Needed
Demolish
Lay Away
Walk Away


Least Cost Alternative - With Environmental Problems
72100 - Unaccompanied Personnel Housing, Enlisted Facilities
Probability Facility Will Be Adequate
1.00
0.80
0.60
0.40
0.20
0.00
0.00
0.20
0.40
0.60
0.80
1.00
Probability Facility Will Be Needed
Demolish
Lay Away
Walk Away


Least Cost Alternative - Environmental Problems Increase
72100 - Unaccompanied Personnel Housing
Increase in Multiples of Current Costs
0
1
2
3
4
5
6
7
8
9
10
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
Probability of an Increase in Environmental Cleanup Costs
Demolish
Lay Away
Walk Away

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ATTN: DAIM-FDP

Defense Tech Info Center 22304
ATTN: DTIC-O (2)

10
12/95